THE GARDEN JOURNAL

THE NEW YORK BOTANICAL GARDEN

Vol. 11, No. 6 November-December, 1961

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THE NEW YORK BOTANICAL GARDEN

DOROTHY EBEL HANSELL
Editor

CALENDAR

November 18, 1961, 3 p.m. Free Saturday Afternoon Programs resume in Lecture Hall of the Museum and Administration Building, with Mr. and Mrs. Philip Bergh giving an illustrated talk, entitled "Little Pageants of Nature, Third Edition."

December 7, 1961. Holiday House Tour, sponsored by the Volunteer Associates of The New York Botanical Garden.

December 14, 1961. Theater Benefit, "Gay Life" at the Shubert Theater, sponsored by the Volunteer Associates of The New York Botanical Garden.

December 15, 1961. Christmas Show opens in the Conservatory of The New York Botanical Garden and will extend well into January, 1962.

January 4, 11, 18, 25, 1962. Downtown Lecture Series, sponsored by the Volunteer Associates of The New York Botanical Garden.

March 10-18, 1962. International Flower Show, Coliseum, New York, N. Y.

March 11-17, 1962. Spring Flower Show, Commercial Museum, Philadelphia, Pa.

March 17-25, 1962. New England Spring Flower Show, Wonderland Park, Revere, Mass.

April 4, 1962. Members' Evening of The New York Botanical Garden, Essex House, New York, N. Y.

April 8-11, 1962. Seventh Annual Horticultural Congress, Norfolk, Va. Headquarters: The Golden Triangle Motor Hotel.

April 27-May 7, 1962. Floralies, International Horticultural Exposition under auspices of Société d' Horticulture and Jardin Populaires de France in Valenciennes, France.

May 1 and 2, 1962. "Tally-ho"—tour and show of The Garden Club of New Jersey (Bedminster-Peapack-Gladstone area).

May 14-16, 1962. Annual meeting of the Herb Society of America at Washington, D. C.; headquarters, Marriott Hotel. Hostess—The Member-at-Large Unit of the Society; Mrs. S. J. Neiburg, Paxton, Ill., Chairman.

August 31-September 8, 1962. Sixteenth International Horticultural Congress, Brussels, Belgium.

April 26-October 13, 1963. International Horticultural Exposition, Hamburg, West Germany.

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While every effort is made by the Editor to avoid errors, the ultimate responsibility for all statements rests with the authors.

CREDIT FOR ILLUSTRATIONS

We are indebted to the Display Committee, Mrs. Charles Burlingham, Chairman, for the selection of the front cover illustration—Within the Conservatory of The New York Botanical Garden by Gottscho-Schleisner, Inc.; p. 194, p. 195, top, lower left, J. Horace McFarland Co.; p. 195, lower right, Gottscho-Schleisner, Inc.; p. 196, left, J. Horace McFarland Co. upper right, Edgar L. Kline, lower right, H. v. Wall—Oregon Bulb Farm, lower right, E. N. Mitchell; pp. 198, 199, Jackson and Perkins Co.; p. 205, John Ahlhauser—Boerner Botanical Gardens; p. 206, upper, Boerner Botanical Gardens; lower, The Milwaukee Journal; p. 207, lower, p. 208, Milwaukee Co. Park Commission; pp. 209, 210, R. G. Gorton; p. 214, Gottscho-Schleisner, Inc.; p. 215, left, E. N. Mitchell; p. 215, right, p. 216, upper, pp. 217, 219, Gottscho-Schleisner, Inc.; p. 216, lower, E. N. Mitchell; p. 218, The New York Botanical Garden; pp. 220, 221, 222, Murray Wright; p. 228, E. N. Mitchell; p. 231, W. Atlee Burpee Co.; p. 232, Wee Carr Studio.

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JANUARY 18, 1962

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Sponsored by The Volunteer Associates of The New York Botanical Garden.

The tour will visit homes overlooking the East River—duplex apartments from 79th Street to 88th Street, as well as Gracie Mansion, the residence of the Mayor of New York—will be shown. These homes, situated in one of the loveliest and most dramatic parts of the city, reflect the gracious living of several eras.

Each place to be visited will be decorated for the holidays, by a florist of outstanding ability, in a manner appropriate to its setting.

A sale of unusual Christmas gifts and decorations will be held at one of the apartments.

There will be two sessions: in the morning from 10:30 A.M. to 1:30 P.M.; in the afternoon from 2 P.M. to 5:30 P.M.

Gracie Mansion, which will be decorated by The New York Botanical Garden, will be open to both sessions from 2:30 P.M. to 5:30 P.M.

Tickets are available from The New York Botanical Garden Downtown Office, 22 East 60th Street, New York 22, New York. For members of The Garden, $8.00; for non-members $10.00.

HISTORY AND DEVELOPMENT OF MODERN HYBRID LILIES

By FRED M. ABBEY

Mr. Abbey has long been interested in breeding lilies. He is the Manager of Gardenside Nurseries of Shelburne, Vermont, and the President of the North American Lily Society.

IT IS DIFFICULT to determine just when the development of present-day hybrid lilies began, for several are being cultivated that have been in catalogs for more than twenty years, and one at least is dated 1810. Interest in the genus *Lilium* lagged, except among a very small number of enthusiasts, and not until the introduction of *L. regale* about 1910 did it begin to quicken. For a while, this easily grown species was of absorbing interest. Eventually a few hybrids of *L. regale* were raised. In 1920 a supposed cross between it and *L. sargentiae* was named *L. princeps;* this later reverted to *L. imperiale,* the name originally applied to it by Wilson in 1920. This was followed by a fine selection, called G. C. Creelman; it resulted from a cross between *L. sargentiae* and *L. regale* that was made by Miss Isabella Preston in 1916.

With the evidence that it was possible to obtain new forms, several persons began hybridizing extensively. Before World War II, quite a bit of breeding had been done, although very few clones had been introduced. In England, crossing of the Martagon types with *L. hansonii* in the 1890's had resulted in the Backhouse Hybrids, but even as late as 1940 very small numbers of these hybrids were available. In France, M. Debras had succeeded in crossing *L. sargentiae* with *L. henryi,* the seedling first flowering in 1928; this achievement was to have considerable influence later on. In America, Tom Barry had produced a similar hybrid with *L. sulphureum* as the seed parent and *L. henryi* pollen; the cross was made in 1933. In Canada, Miss Preston, who was working with other species, sent out the Stenographer Group, some of which first flowered in 1932. This was the situation at the beginning of the 1940's. Most of the presently popular forms are therefore not over twenty years old.

Certain conclusions that I have drawn and shall state in this article are my own; also some names and dates have been taken from memory and could not be readily verified.

There appear to be six general lines along which present-day lilies have been developed. No one would dare to say which is the most important, or the first to become popular. Listing them is a matter of convenience, and so I start off with hybrids of *L. regale.* Next comes the Aurelian group, or hybrids derived from trumpet lilies that have been pollinated by *L. henryi.* For those who can grow them well, there are a number of good forms and hybrids of *L. auratum* and *L. speciosum,* more perhaps of the former than of the latter.

With the same reservation—ease of culture—I must include developments in the Martagon Group. Martagon or Turks-cap lilies have been crossed with the Korean *L. hansonii* to give hybrids that differ widely in colors, but have no marked change in the form of the flower.

The same can be said of a group usually called the Patterson Hybrids, in which changes have occurred in color, vigor, and flowering periods; but again the form of the flower has changed but little. Last and probably latest are the many fine hybrids developed from crosses made between *L. tigrinum* and *L. hollandicum,* beginning with 'Enchantment' and continuing to the recent introduction of a yellow-flowered variant of *L. tigrinum* that is giving eastern hybridizers some unusual results.

At present work is being done and results are being achieved in hybridizing both the eastern and the western native species. Beyond any doubt, a few crosses have been made that cannot be included in the above six lines. These, however, are not yet important and can be disregarded except to comment that such work should be given every encouragement. When we consider what has been attained in the past twenty years, there is every reason to expect that the next twenty years will give us much more.

A careful reading of Wilson's *Lilies of Eastern Asia,* in the light of present developments in trumpet lilies, cannot fail to impress one with the fact that these are quite closely related. It is true that *L. regale* and *L. sargentiae* differ in a number of characteristics (one bears bulbils, the other does not, for example); still when they were crossed, the latter being used as the seed parent, the very first generation produced forms intermediate between the two. These were named the Shelburne Hybrids. When *L. regale* was the seed parent, the results were less pronounced, but they would seem to prove that geographical distribution had produced in *L. regale* a very true-breeding strain. Later on, the use of *L. centifolium* (as *L. leucanthum* var. *chloraster* is known in lily circles) quickly produced varied results. As far back as 1933, a slight pink coloring was noted in seedlings of several of these strains, and eventually the lovely pink trumpets made their appearance. Yellow also became dominant with the use of a clone known as Butterfield lily, said by some to be derived from work done by Luther Burbank. The Olympic Hybrids have much *L. centifolium* blood and are characterized particularly by the magnificent pyramidal inflorescence. There are pure white, soft yellow, and soft green forms. The extra bud on the pedicel is a recent development; this bud was never found in the species.

Names that are associated with these lilies include L. N. Freimann, who first observed a pink coloring in some of the strains on the West Coast; Carleton Yerex, who noted it in some seedlings of Shelburne Hybrids that were sent to him from Gardenside Nurseries, where this color appeared shortly after and resulted in several clones of merit. Jan deGraaff's Olympic Hybrids are famous. Eric Mayell and John Shaver have also sent out fine strains. Another name, now often forgotten, is that of L. H. Abel. He com-

Lilium centifolium

bined some of the early hybrids from the best of several eastern strains and came up with the Green Mountain Hybrids. Dr. E. F. Palmer worked with the more pronounced yellow sorts—among them *L. sulphureum* and *L. sulphurgale* (which resulted from crossing *L. sulphureum* and *L. regale)*—to produce varied shades of soft yellow, one of which was named 'Galahad'. These hybrids seem close to his introductions in the Aurelian Group, but they are placed in the trumpets by those who are supposed to know their lilies.

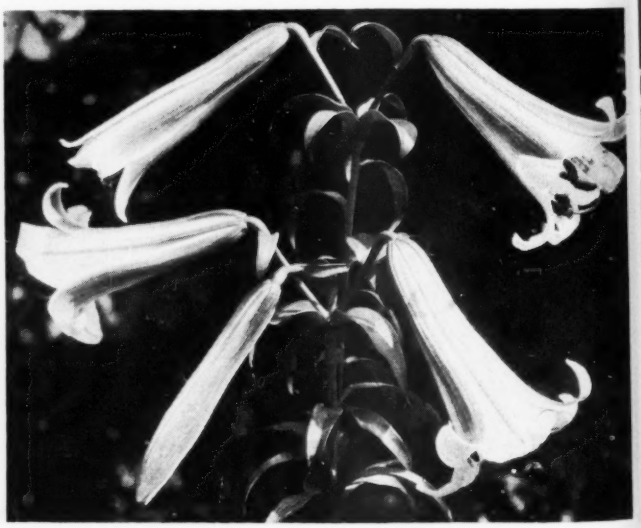
Perhaps the Aurelian Hybrids vary in flower form more than any other group. They resulted from crosses between a trumpet parent, *L. sargentiae,* and a Turks-cap, *L. henryi,* one with curled-back petals, and the progeny may be like either parent, or intermediate. Some of the loveliest are those that have the narrow segments of *L. henryi* and are flat or curl back only at the tips. Since both parents contributed yellow as the basic color, it is not surprising that the offspring vary from intense orange through softer shades of yellow to white. If the seedlings from Tom Barry's Havemeyer lily are included in this group, the color range is extended to greenish yellows, and more recently to bicolors. There are early and late strains, some of which prolong the flowering period into September. There are widely flared trumpets, and finally there are pink-shaded Aurelians. While this group was first raised in France, much has been done with it in this country, and the name of Dr. Palmer must be placed close to the top. Carleton Yerex and Jan deGraaff have also sent out many spectacular forms. In the Midwest, Mrs. Martha Mears has done excellent work, and Edgar Kline has assembled and increased some of the best of Tom Barry's seedlings.

This is one of the most easily grown groups of lilies; it is hardy; not free from disease, but very virus-tolerant and does well even when infected; and flowers over a long period. These lilies have been used widely as a basic strain for hybridizing, and beyond any doubt are responsible for some fine forms among the trumpets.

Developments in the *L. auratum–L. speciosum* group are spectacular, but not all can be considered hybrids. As is well known, the historian Francis Parkman succeeded many years ago in raising a hybrid from a cross between these two species. It was lost, and it was not until recently that Parkman's lily was re-created in Australia and named 'Jillian Wallace'. Since then we have learned that when these two species are crossed, they produce viable seed, but the seed secretes a substance that kills the germinating seedlings in a short time. Dr. S. L. Emsweller of the United States Department of Agriculture, Beltsville, Maryland, has done most outstanding work in growing this cross, by excising the embryo and keeping it alive, under sterile conditions in test tubes and agar, until it could be put into the ground. The first of the seedlings so produced trace back to some hybrids developed by Dr. George Slate of Geneva, New York; they were called the Potomac Hybrids and immediately became popular. Further crosses of *L. speciosum,* back on *L. auratum* by *L. speciosum* forms, have given a still newer group of Potomacs, which are not only magnificent but seem to be of easy culture under eastern conditions. For the most part, the forms of *L. auratum* or hybrids of it, if they are really hybrids with *L. auratum* as the seed parent, are not of easy culture in the East; and it must be suspected that most are further crosses on the basic *L. auratum* by *L. speciosum* or else are variants only of *L. auratum.* Where they can be grown well, these two, with either their hybrids or variants, are among the most cherished of garden lilies. It is to be hoped that their susceptibility to disease will vanish with the newer forms.

L. martagon and *L. hansonii,* originally crossed in England, produced a number of fine hybrids; among some of the best are the well-known Backhouse Hybrids. Later crossings may have repeated the original ones, or may be seedlings from the original. In any case, several strains are now available. Dr. Slate has worked with these little jewels for years, and he continues to do so. In Oregon, Edgar Kline has developed his strain of Painted Ladies, and Mr. deGraaff

Lilium sargentiae



his Paisley Strain. In the East, W. C. Horsford is raising a very diverse and vigorous group, which is not yet named or introduced, and Dr. Norma E. Pfeiffer of Yonkers, New York, has a strain named Terrace City Hybrids. All of these need a little shade for best results and seem to require a heavy loam. When they are growing in the right conditions, they are most spectacular; there can be upward of sixty small and unusually colored flowers on each spike, each reaching up to six feet in height. It is to be hoped that their susceptibility to basal rot, which is distinctly a limiting factor in their culture, may be overcome. They usually escape mosaic disease.

In working to obtain lilies that would be hardy on the northern plains, Dr. C. F. Patterson of the University of Saskatchewan used *L. cernuum* with *L. willmottiae* and *L. tigrinum,* and possibly some of the Stenographer Group. From his crosses have come some of the most delightful new lilies, particularly hardy. They are mostly of the Turks-cap type, as are all the parents, but the colors range from white to pink to rose, and also to yellow. They need only an extension of their flowering period, late June and well into July, to make them the most comprehensive new group available. Heat, drought, and cold do not seem to bother them. Dr. Patterson's recent death may put an end to further introductions from this source. However, others have begun working to enhance their values, and the deGraaff Harlequin Hybrids must be mentioned. At present, however, none surpass the Patterson Hybrids in their season.

Many fine lilies have resulted from crosses in which *L. tigrinum* has been used as a parent with early cup-shaped species and probably with nodding sorts as well. It is difficult to keep up with all the developments, and one might wish that there were less duplication in form and color. All are easily grown, of course, and generally are persistent, soon making fine clumps. It would be useless to attempt to select any one lot as particularly outstanding, for it is

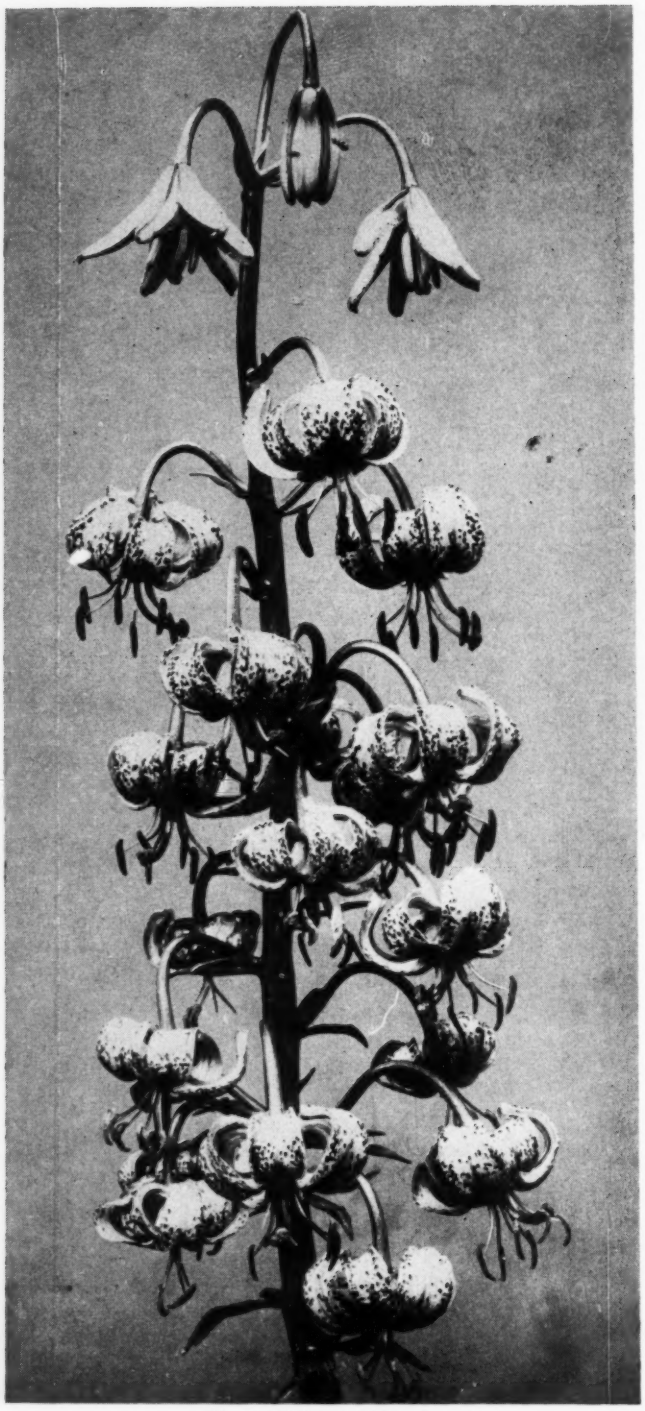
Lilium sulphureum

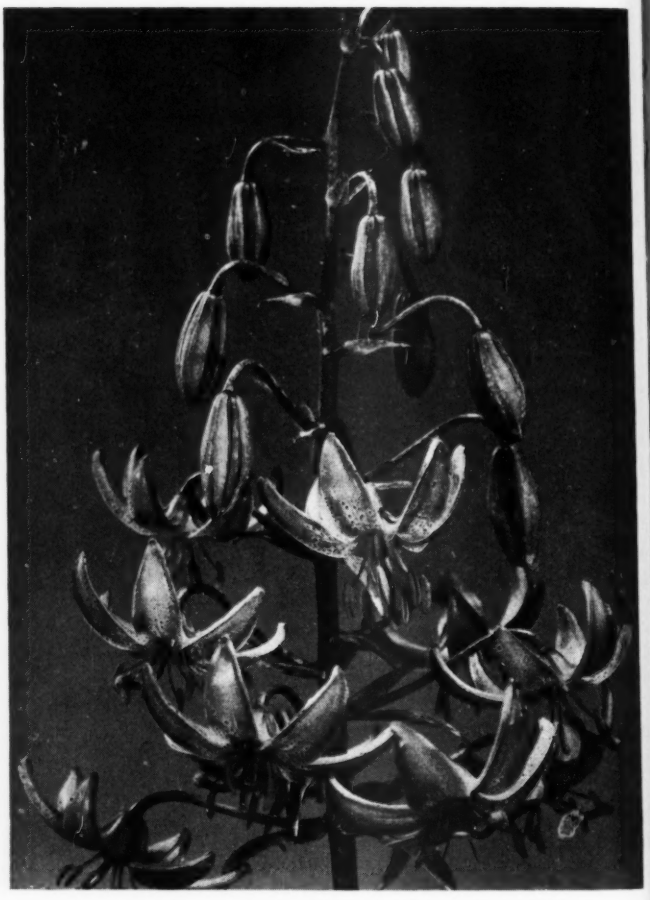
almost certain to be superseded in a very short time. Mr. deGraaff has done considerable work with *L. tigrinum.* The names of Percy Byam, Dr. Palmer, and J. C. Taylor, all of Canada, are associated with these lilies. Dr. Frank Skinner, also of Canada, has worked with a number of *Lilium* species. All these men have given us varieties of great beauty, finish, and ease of culture.

The introduction not too long ago of the yellow-flowered

Lilium henryi

Lilium tigrinum





Above. *Lilium martagon.*

Upper right. The Painted Lady Strain by Edgar L. Klein.

Lower right. The Paisley Strain by Jan deGraaff.

L. tigrinum stimulated further crossing on this as a parent or with its pollen on other species. The results fall in two general groups: one with upright flowers; the other with outward-facing flowers. Their colors are vivid, with a high sheen. The plants are very vigorous. Perhaps the most notable improvement is that there are often two, and sometimes three and four flowers to a pedicel, and this gives an exceptionally long period of bloom. The names of two Connecticut men, David Stone and Norman Lamb, are closely identified with these new forms.

Mention of Connecticut reminds me that Ralph Warner of that state was probably the first to raise seedlings of which one parent was the lovely pink *L. japonicum* and the other *L. auratum*. [Dr. Pfeiffer was the first to cross these two species: she crossed *L. auratum* by *L. japonicum* and published the results a couple of years before Mr. Warner reported.] This work is being continued in Oregon with the very early pink *L. rubellum* and *L. auratum*. The hybrids carry coloring quite different from the stronger colors of *L. speciosum*. Continued cross-breeding may achieve the ease of culture that they do not yet possess.

Hybridizers think first of all about producing an unusual bloom. But some of their efforts should be aimed at obtaining greater disease-resistance or virus-tolerance. Natural selection helps, for varieties that fail to do well are sure to disappear from lists. And this may happen to many of the new forms now appearing, as has happened to new forms of gladiolus, irises, and day-lilies.

Three major diseases attack lilies. First is botrytis blight, caused by the fungus *Botrytis,* which spoils foliage and blooms and is very prevalent in wet seasons or in areas where the humidity is high. Attempts have been made to breed immunity to this disease in the newer forms, but indications are that botrytis, too, is changing. The best control at the present time is a covering coat of fungicide; Bordeaux mixture is recommended, and very good results are attained by using a neutral copper dust. Both will discolor the foliage, but the latter is less noticeable. It is necessary to begin applying either remedy before the disease strikes, since it cannot be eradicated by any method.

Basal rot caused by *Fusarium* is present in most garden soils. With the excessive use of manure, it may become quite virulent and seriously weaken bulbs. Certain species and hybrids are more susceptible than others. If trouble is experienced, it is good sense to try other lilies, or at least to move the bulbs to new soil; first clean off infected scales and soak the bulbs in captan or a similar material. If properly proportioned, captan or "Tersan" can do no harm and may prevent reinfection. Soil sterilization, though recommended, is usually difficult to manage in the mixed garden border or bed.

Much has been written about the virus that produces mosaic disease, but no effective control is yet known. Some species are able to grow well even though they contain the virus, and their use in hybridizing may develop greater resistance in their progeny, or at least the ability to live with one or more of the virus strains may be passed along to forms that cannot now do so. A combination of several virus strains is usually fatal to most lilies, although *L. tigrinum* seems able to survive under any condition, another factor in the present interest in its use as a parent. But it must be remembered that growing resistant strains of lilies that are infected with a virus is a danger to the more susceptible species in the same planting. As aphids carry the virus, it is necessary to spray to prevent the spread of this pest to the lilies. Systemic insecticides do this very well.

A recent development at the Beltsville Station of the United States Department of Agriculture is of interest. Scientists there have found that newly developing scales of lilies that are known to carry the virus diseases may be

(Continued on page 224)

Olympic Hybrids by Jan deGraaff.

Lilium auratum platyphyllum rubrum in a border at The New York Botanical Garden.

THE CHRISTMAS-ROSE

By DOROTHY EBEL HANSELL

THE CHRISTMAS-ROSE is actually not a rose, but a member of the buttercup family or *Ranunculaceae;* its botanical name is *Helleborus niger.*

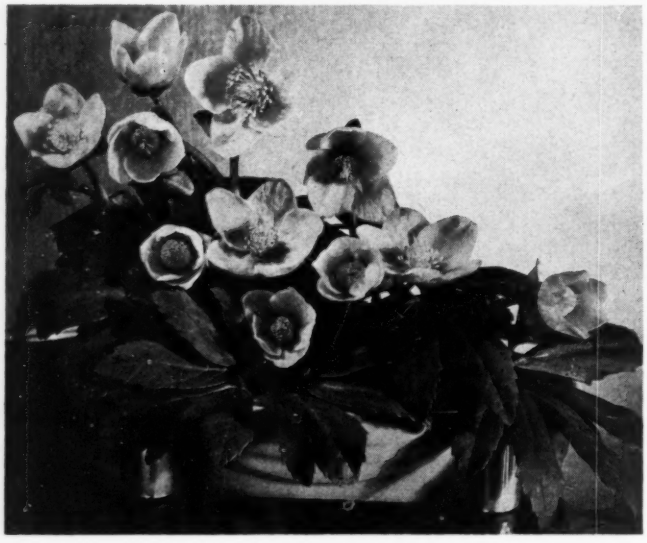
This hardy perennial, native of many parts of continental Europe and Asia Minor, was introduced into English gardens more than three hundred and fifty years ago—as far back as 1596, so the records indicate. Some years later it was brought to America, and occasionally large clumps are found in very old gardens.

The Christmas-rose gives an out-of-season touch to the garden, for it bears its flowers in winter when practically all hardy perennials have retired from the scene and are resting. My first sight of the Christmas-rose was on the W. G. Mather estate in Cleveland, Ohio, a number of years ago. It was a bitter cold day, with wintry blasts blowing from Lake Erie across this lake-shore estate—certainly not the kind of day I should look for flowers at my feet. Yet beneath a pleached allee of beech trees were over a hundred exquisite off-white flowers. Some had a greenish cast to their petal-like sepals, some were flushed a delicate pale pink. The prominent golden stamens and attractive palmately-divided leaves of a leathery texture added to their startling beauty.

These Christmas-roses were flourishing in a sandy loam that had been enriched with well-rotted manure and leafmold. They were given plenty of water from June to October, were shaded for half the day, and were protected from strong winds under the pleached allee.

Amateur gardeners are told that *H. niger* is sturdy and reliable and not a difficult plant to handle. However, they sometimes meet with disappointment when they try to grow it, because they may have overlooked one of the basic conditions for its successful culture. Christmas-roses must be grown in moist but well-drained, enriched sandy loam;

The Christmas-rose is arranged effectively with its own foliage in a low container.



The Christmas-rose bears its blooms above snow-covered ground.

they must be shaded for at least half the day, and preferably after mid-day; and they must be protected from strong winds. During their growing period, June to October, they must be provided with an adequate supply of moisture. They do well in a shrub border, in an open wooded area, or in a foundation planting on the east side of a house, and should be left undisturbed until they have outgrown their location. Dividing the clumps—May is the best time for this operation—and transplanting them will increase the number of plants but will reduce the number of flowers.

In planting, the divisions should be set in holes large enough so that the roots are spread out, and the eyes, or crown buds, are a half inch below ground level. When the eyes are set level with or above the ground, they are likely to dry up from spring winds or summer heat. If the divisions are placed twelve to fifteen inches apart, they will have ample room to develop and will not need to be moved for some years.

Helleborus niger is sometimes troubled by insect pests and diseases. If aphids become a nuisance, they can be controlled by spraying with a lindane or malathion insecticide. Browning of the leaves is sometimes noticeable in midsummer; this is caused by too little shade, insufficient moisture, or too shallow planting, and any one of these errors can be corrected. Black spots may appear on the leaves in late fall, if the weather is unusually cold and wet. These spots can be treated with a sulphur dust or a mild dose of one of the sprays used for black spot on roses. Crown-rot, the same disease so common with delphiniums, may attack the Christmas-rose, in which case better start with new plants in another part of the garden.

Since the sepals may be spattered during stormy weather,

clean straw, peat moss, wood chips, or a layer of dried leaves may be placed around the plants as the flower buds develop. Some gardeners put a cloche over the entire plant; others build a ventilated, glass-covered box large enough to enclose their entire planting of Christmas-roses. Any one of these methods will keep the flowers from being marred, and this is especially desirable if they are cut to be used in arrangements. They make exquisite arrangements, with just their own foliage, in low bowls. The late Miss Hester Franklin of Murray Hill, New Jersey, cut flowers generously from her plants. These had been growing on her family's place for many years and had spread to such an extent that they looked as if they had been naturalized. One year, a few days before Christmas, with several inches of crusty snow covering the ground, Miss Franklin carried a low white bowl filled with Christmas-roses and their dark evergreen leaves to the New Providence Library. The Library was then housed in an old wooden building, painted white on the outside, rather drab within. The Christmas-roses gave it life and sparkle. I can still hear the exclamations of surprise and delight as visitors came in from the cold outdoors and saw the lovely white flowers on the librarian's desk.

Selma Lagerlof has written an enchanting story about the Christmas-rose.* It tells how Robber Mother from Göeinge Forest, who had gone begging to Övid Cloister, entered the gate, although forbidden to do so, when she saw the colorful herb garden. Abbot Hans heard the confusion caused by her presence in the cloister and joined the lay brother and several monks who were trying to force her to leave.

Robber Mother said to Abbot Hans, "First, when I saw this, I thought I had never seen a prettier garden; but now I see that it can't be compared with one I know of." She was referring to the beautiful garden into which Göeinge Forest was transformed every Christmas Eve.

Abbot Hans had long wanted to witness this miracle, so he arranged with Robber Mother to have one of her children guide him and a lay brother to Robbers' Cave on Christmas Eve. There they all waited until the dark forest was suddenly illuminated.

"Then Abbot Hans saw that the snow had vanished from the ground, as if some one had removed a carpet, and the earth began to take on a green covering. Then the ferns shot up their fronds, rolled like a bishop's staff. The heather that grew on the stony hills and the bog-myrtle rooted in the ground moss dressed themselves quickly in new bloom. The moss-tufts thickened and raised themselves, and the spring blossoms shot upward their swelling buds which al-

The Christmas-rose flourishes above a mulch of leaves and against a background of evergreens.

*The Legend of The Christmas-Rose by Selma Lagerlof, translated by Vera Swanston Howard. Copyright 1910 by Selma Lagerlof. Used by permission of Doubleday and Company, Inc.

ready had a touch of color."

Abbot Hans was awed by all this beauty, but the lay brother exclaimed it could not be a miracle of God, but must have its origin in witchcraft. Immediately all the wondrous beauty vanished. "Darkness sank over the earth like a coverlet; frost came, all the growths shrivelled up . . . the leaves dropped from the trees rustling like rain."

Abbot Hans fell upon the ground. Clasped in his hand were roots of the flower he had promised to bring back to Bishop Absalon. The lay brother planted and cared for the roots, but they gave so sign of growth. But on Christmas Eve the lay brother, thinking about Abbot Hans, walked into the garden. There he found a beautiful white flower.

"It has been named the Christmas-rose. And each year at Christmastide she sends forth from the earth her green stalks and white blossoms. . . ."

ADVENTURE IN ALASKA

The following excerpts of a letter from Dr. William C. Steere, Director of The New York Botanical Garden, to Henry de la Montagne, Assistant Director Emeritus, will interest readers of *The Garden Journal*, revealing, as it does, the vicissitudes of field work in northernmost Alaska. Dr. and Mrs. Steere spent over a month there this past summer, under a grant from the Arctic Institute of North America, working out of the Arctic Research Laboratory at Point Barrow.

"DOROTHY AND I got back to Barrow early Wednesday morning (July 26, 1961) after a week in the Brooks Range. We had planned to be away from the base from ten days to two weeks, spending about three days in each of three places. However, we had no more than arrived at Liberator Lake, which is on the northern front of the Brooks Range almost straight south from Barrow, at a latitude just below 69°, when the weather deteriorated. We encountered wind, rain, and snow in various combinations every day we were in the field. The only useful purpose of these adverse weather conditions was to ground the mosquitoes—there were hordes of them because of the wet tundra. In the absence of sand or gravel, we had to pitch our floorless tent right on the marshy tundra—a very "squishy" underfooting. With the rain beating down on our tents most of the time, even our sleeping bags were wet. What brought us back to Barrow was not this certain measure of discomfort, but the fact that our plant specimens could not be dried and were beginning to show ill effects from so long storage in plastic bags.

"We were camped on the south shore of Liberator Lake, with a one-thousand-foot ridge a half mile south of us and still higher mountains behind it. For some reason these ridges caused the most amazing turbulence with a south wind that I have ever experienced. All night, almost every night, we went through cycles of a complete lull in the wind, then, wham! came a gust of full-gale proportions which would threaten to take down our tent. Fortunately, I found a couple of empty gasoline drums to hold the most important stakes into the soggy ground and so, although our tent flapped and ballooned, it never actually left us.

"About midnight on Monday (July 24, 1961) we heard a small plane, right in the midst of the most gusty downdrafts, and rushed out to see if it was the plane that was scheduled to move us. However, we saw that it had wheels instead of floats; it had come to check on us as well as to drop some extra mosquito repellent. Because of the terrific wind, the plane could not get the drop within a mile of us, and both the repellent and the pilot's pistol, as we learned much later, went into the lake. We found out on our return to Barrow that the pilot considered himself lucky to have gotten off 'with his skin'—the plane itself had popped the paint off many rivets from the buffeting.

"The weather began to clear on Wednesday, and that night the float-plane arrived to move us to our next place of operation. However, because of the wet and spoiling specimens, we sadly decided to return to Barrow.

"The pilot had to move a couple of investigators from one camping spot to another in Howard Pass, about seventy-five miles southeast, so I went with him in order to see another area. These investigators, by the way, are graduate students of Dr. John Tedrow, the soils expert at Rutgers and an old friend of mine. I had expected to find him there, but he had been forced to return home to testify in a murder case in which, in true detective fashion, the suspect had some special sort of earth in his trouser cuffs. Moving Tedrow's graduate students took much longer than anticipated, as these small float-planes do not have much capacity, even with the seats taken out. We had expected to be back at our camp by midnight; it was 4:30 a.m., when we finally returned—and Dorothy, naturally, was quite worried. We gathered our personal gear together, got ourselves and our soggy specimens into the plane, and were back at Barrow at 7:00 a.m. This is perfectly in form for travel on the Arctic Slope—nothing is predictable. But a completely unpredictable experience is a stimulating environment for getting out of ruts and for restoring perspective.

"We are going into the field again on Sunday. The bad weather should be almost over, at least so the statistics on rainfall indicate. We hope to be back here (at Barrow) Wednesday night or Thursday morning and will spend a couple of days in drying specimens, packing, and shipping them. This trip will finish what we had planned to do on the last one. Our tents and cooking gear are still at Liberator Lake, and we shall just pick up from there. We are due to land in New York early on August 8 on the night jet flight from Seattle.

"This has been a very short summer, but extremely interesting and unexpectedly successful botanically. I keep thinking that little that is new and exciting can possibly turn up here, and yet this summer has been as rewarding as the past ones.

"The most interesting plant we collected is a little hepatic whose closest relatives are tropical and subtropical. This is a distribution pattern that I have already discovered here in previous years, and undoubtedly reflects a much warmer climate at some time in the geological past, either before the Pleistocene ice age or during one of the longer interglacial periods. Also, the Aleutian Island chain is a relatively recent development, and before it arose, the Japanese current undoubtedly circulated into the Bering Sea. The relation between geology and plant geography is a close one."

RECENT ENDEAVORS WITH COMPUTERS IN TAXONOMY

By DAVID J. ROGERS

Dr. Rogers is Curator of Economic Botany at The New York Botanical Garden.

SEVERAL TIMES during the past two or three years items have appeared in *The Garden Journal* indicating that I have been doing something with various types of electronic devices for the computation and correlation of botanical information. These items, given without any introduction, and only fitfully reported, may have been a bit confusing to the readers, and perhaps it is time to review this field of endeavor, telling what has happened, what the present operations are, and what may develop in the future.

It would be interesting to start with a history of the development of data-processing devices, but this is beyond the scope of this report. Suffice it to say that the idea for the devices that can handle large quantities of data (numbers, representing information) is not new, and during the past century several mechanical devices were built to carry out the same types of calculations and operations that are today no longer mechanical, but electronic in method. We still use many mechanical devices in the operations along with the electronic devices, and often it is better or cheaper to use filing cards, hand-written or typed, or cards that are notched along the edge or have holes (square or round) punched in designated spots to code certain pieces of information. All such mechanisms must be considered as nothing more than tools to relieve people of the drudgery of tedious operations, and to help jog faulty memories.

Anyone, upon a little reflection, will see that there are different levels of complexity to the devices now used in almost every facet of our life. Billing for the large magazines is done with punched cards. Life insurance companies would be deluged in paper work, unless they could record statistics in more condensed form on similar cards. But the punched card by itself is of very little use—a hole in a card means little; the hole has been designated to carry one piece of information only, such as the expiration of a subscription, how much you still owe on your automobile, the color of your eyes, your age; or, in the case of plants, whether a particular species is a tree, shrub, or herb, the color of its flowers, the shape of its leaves, and so on. What do you do with this information once you have set up a card system? I suppose some people just like to accumulate cards, like the patient who said, when he found that his doctor liked pancakes, "Oh, Doctor, I'm glad you like them too—I have trunks *full* of them!" We try to steer clear of this.

All kinds of information (and data are kinds of information) must be put into some order of relatedness to have meaning. The more information, the more difficult the job of keeping it related. Eventually, the punched card becomes cumbersome for storing information, and some more sophisticated device must be found. We have all seen TV reports of elections predicted by "electronic brains"; usually during the program the TV camera is sooner or later focused on a series of tall boxes in which reels of tape are being erratically jerked back and forth. We know that those reels carry tape on which are recorded thousands of electric impulses, each impulse more or less analogous to the hole in the punched card in that by its position on the tape (the address) it is coded for a particular piece of information. By using electronic tape instead of punched cards, much more information may be stored in a much smaller space.

As more information is stored, more possibilities for its use may be found. When certain quantities of information are stored, we may re-organize the information in many different ways to get new, or different, sets of correlations from the same information. Let's see how this might work in a botanical setting. Suppose we have a set of punched cards on which we have recorded (at specific spots on the cards) the known species of the genus *Acer* (maple), the geographic distribution of each species, the botanical characteristics for identification (lobing of the leaf, the shape and size of the winged fruits, and so on), and the uses. You may wish to know which species of maple (if any) may be found in a particular section of the country. Were this information recorded, it would be a rather simple matter to pass our cards through a sorter, coded to retrieve the information on distribution, and have those cards drop into one pile with the desired geographic distribution of the maples. Another person may ask that the cards be sorted with more than one question in mind to make rather simple correlations of information. Indeed, it is frequently useless to employ more complex machinery than the card punch, the electronic sorter, and the collator. On the last two machines, both electronic and mechanical devices aid in the operations that the two are designed to perform.

The New York Botanical Garden, thanks to a grant from the National Science Foundation, is sponsoring a very large project that uses the above devices. This project is essentially a straightforward bibliographic endeavor to record all the scientific names of plants, and will also include information on the botanists who first named the plants, the places of publication (journal, book, or other scientific publication), the dates of publication, and other useful data. This program will not attempt to identify the plants, or to do any taxonomic work. Its purpose is, as stated, to produce a catalog of and reference to the scientific names that have been applied to plants.

In this particular project, the stored information need not be recalled (or retrieved) in a very short time, because it will be a reference work to be used for organizing catalogs or indexes of information, among other purposes. These indexes will be printed, and may provide an important adjunct to botanical research of many kinds, including taxonomy, ecology, physiology, and economic botany.

However, there are problems in systematic botany (taxonomy), as in most other branches of science, in which

the punched card, the sorter, and the collator are too slow for the most efficient operations. In the problems mentioned, to be discussed in more detail later, any particular bit of information may be needed almost instantaneously; for this purpose, electric circuits are important, and the information must be transmissible over these circuits. Therefore, a hole in a card becomes an intolerable hindrance to speed, and here the electronic tapes come into play. There are other ways in which information may be stored electronically, and from which the information may be recalled even more rapidly than from the tapes. With these techniques, some particular bit of information may be recalled in a very small fraction of a second.

The history of the electronic computer is another fascinating story, but again, this is not the place to develop it. We know that the pressing logistics problems of World War II pushed the development of the computers much more rapidly than would possibly have happened under peace-time conditions. Their development has been rapid, and today our whole economy might grind to a halt if we suddenly had to remove the computers from the telephone companies, the large heavy industries, and from the financial centers of the United States. Much of our science would be impossible without the computers to store and recall information that could never be incorporated into the mind of an individual. This statement is truest in the physical sciences, particularly in the sciences dealing with space.

Slowly the computers and their associated rapid printers are finding their way into the biological sciences. As our knowledge grows, and as problems become more complex, we shall depend more and more on these devices for their labor-saving capacities. The very high cost of producing an adequate scientist today demands that we use the scientist's capacity to the fullest. We must not hamstring him by demanding that he use nineteenth-century techniques for storing and retrieving vital data needed in his work. The growing tendency for science to cut across traditional lines of endeavor is another pressing reason for scientists to employ rapid information retrieval and data processing. The interdisciplinary endeavors in biology are reflected in such terms as biophysics, biochemistry, and more recently, the term biomathematics.

It is frequently heard among various groups of people, both scientists and certain knowledgeable laymen, that the science of taxonomy is passé, that the classification of organisms, both animal and plant, is satisfactory as it is, and that nothing more can profitably be done by exploring old problems further. This attitude unfortunately reflects the greatest ignorance of the real problems. The real value of taxonomy lies in its ability to correlate information, to show the relationship of organisms, and to shed more light on their various living functions. True enough, one aspect of taxonomy is in cataloging the plants themselves, and one might assume that once done, there is nothing else to do. However, as more scientists study more and more details of the fine structure of various experimental animals and plants, it is often imperative to re-organize the cataloging system in the light of their newer information. The process at its simplest level in taxonomy will therefore be constantly going on, reflecting the latest endeavors of the many biological sciences.

A criticism that has validity in scientific circles is that taxonomy, as it is largely practiced today, is more of an art than a science; that there is no quantification, nor demonstration of the methods by which conclusions are drawn. The theories and hypotheses utilized by systematists are seldom fully supported by their data.

At this point, the value of the computer comes into play. Several pioneering workers have attempted to use the computer in studying various complex groups of organisms. P. H. A. Sneath in England employed a computer to assist in correlations among various taxa (units, or entities) of pathogenic intestinal bacteria. Many biochemical tests have been used to differentiate the types of these important organisms. Some of the tests gave good data for taxonomic purposes, others gave inconclusive evidence either for keeping two or more types together, or for separating them. In all some seventy-five to one hundred tests were applicable to the several hundred organisms tested. Different bacteriologists used one or another of a small set of tests on which to base decisions of a taxonomic nature; naturally, there was considerable confusion among those interested in the identification of the various pathogens. This becomes important for the medical pathologist, who must identify the organism suspected of a particular set of symptoms and, on the basis of his identification, advise the doctor on the correct curative procedures. This is one case where a taxonomic decision can be vital. Fortunately, most taxonomic decisions need not be of primary importance in determining such a vital issue. Sneath felt that such decisions could be more accurate if he could correlate all the tests, and from these correlations make more objective judgments as to whether one particular organism is indeed different, or the same as another. One merely has to judge the enormity of the task of correlating the results of seventy-five tests for each of several hundred bacterial types, separately and in various combinations, to know that the only suitable approach that could be made would be with an electronic computer. In this, the data resulting from each of the tests for each type could be stored and then by suitable directions the computer could make the necessary comparisons. Needless to say, no taxonomist had ever before employed such a large number of characteristics with so many different types of organisms. No judgment of the relationship of the organisms, or the lack of relationship, was ever based upon such a wealth of data. It is unlikely that the decisions made by Sneath, using the computer as an extra correlative tool, will be upset by any further single test. In all fairness, it must be stated that Sneath's work did not upset previous studies very seriously. He confirmed some former judgments of relatedness, and was able to prove rather conclusively that other organisms were different from what they were formerly considered to be.

In the same year that Sneath published his work in London, two American entomologists at the University of Kansas, Michener and Sokal, demonstrated conclusively that the computer analysis of data from many species of bees was more adequate and much more rapid than previous techniques in taxonomy. Fortunately, these two had the experience of many years of previous work in bee taxonomy, and they were able to judge accurately the validity of their computer work. This has more value than is im-

mediately apparent. First, the computer work affirms that previous sound taxonomic work is not upset by analysis of additional characteristics, and that good taxonomic judgment, though intuitive, is valid. Secondly, and this is perhaps the more important, taxonomists may now quantify their observations rather than arbitrarily state that such and such a species is related to, is the same as, or entirely different from another. Such quantification will have the effect of permitting more ready acceptance of a taxonomic decision than has been heretofore possible. I am sure that some of my taxonomic colleagues will disagree violently with the last statement, and they may have justification for their stand. It is already possible to judge the adequacy of a taxonomic decision, without quantification, by recourse to the specimens cited by the taxonomist in his reported studies. But most working biologists, who deal with organisms in other fashion than taxonomic, haven't time to check each decision made by the taxonomist. It behooves the taxonomist, therefore, to use all available methods to assure himself of the adequacy of his work.

In 1958, Taffee Tanimoto and I made our first public report on the use of electronic computers in the taxonomic studies of a tremendous number of varieties (cultivars) of a tropical root crop, *Manihot esculenta.* For some time, I had been collecting samples of this highly important tropical food resource in order to make a sound classification of the cultivars and to show the relation of the cultivated species to the wild species in the same genus. As more collections were made, and more data accumulated, it became evident that I could not possibly correlate the various bits of information with ordinary taxonomic procedures.

In order to understand the methods employed in using the computer for taxonomic work, it was necessary to examine the basic assumptions and procedures in taxonomy. The taxonomic method had to be converted to computer language. This process in itself had great value, because I really had to get down to the fundamental principles, which previously I merely assumed, and to accept, modify, or discard them. This activity, which would form the basis of another paper entirely, will not be discussed here. It is well to say, however, that those of us who have used the computer have become aware of the necessity of this reexamination of fundamental taxonomic tenets, and it is likely that much more will be said about these problems in the near future.

If we evaluate the normal procedures employed by the taxonomist—the sorting of specimens, the examination of the literature to see how earlier workers have classified the same or similar plant groups, the integration of geographic distribution, the accumulation of genetic and ecological data—and by means of the computer speed up the difficult and slow parts of the process, then the techniques described below may have some value. Our program simulates the endless process of comparing each sample with every other sample in order to establish the degree of similarity between the two and thus to sort the samples into natural groupings or clusters for classification. No set judgment of the nature of a species or other taxon is implied. I, as a taxonomist, must decide what rank (species, subspecies, variety, etc.) will be assigned to the group.

At the beginning of the attempt to classify the varieties of *Manihot esculenta,* I did not know which characteristics of the plants would be most useful in the classification process. It was necessary, therefore, to collect as much information on each cultivar as possible in order to prevent the exclusion of some useful "measuring stick" for classification. For each variety, a photograph against a standardized photographic backdrop was made. All possible field information was included. Colors of the various parts seemed to be important, and they were recorded. Herbarium specimens were prepared to be used later for those characteristics that do not get lost in the pressing and drying process. The type of soil in which the plants were growing, the common name applied to the cultivar (if one were given), data on the use of the variety, all may have some significance for demonstrating the relationships of that cultivar to another.

Upon return to New York, all the data so collected, which were in very rough form, were placed in an ordered sequence. First, for each characteristic chosen, suitable subdivisions (attributes) of the characteristic, giving the range of variation of that characteristic, were established. For example:

Characteristic	Attribute	Presence
color of petioles	red	no
	red-green	no
	green	yes
	yellow-green	no
leaf-lobe number	3-5	no
	6-8	yes
	9-	no
HCN p.p.m.	less than-10	no
	11-30	yes
	31+	no

Note that the attributes chosen must be mutually exclusive, and that no more than one "yes" may be present for each characteristic. In a similar way, a wide range of characteristics are eventually tabulated, the number of characteristics used being determined only by their availability. Ideally, the characteristics should be inclusive of all evidence ever accumulated: genetic (including chromosome number, morphology, degree of ploidy, etc.), physiological, and ecological, as well as the standard anatomical and morphological characters.

Once the characteristics have been tabulated as above, they are prepared for the computer by recording each "yes" as a "1", and each "no" as a "0", thus:

TABLE I

Characteristic	A				B				C		D				
Attribute	a	b	c	d	a	b	c	d	a	b	a	b	c	d	e
Sample no. 1	0	0	0	1	1	0	0	0	0	1	0	0	1	0	0
Sample no. 2	0	0	0	1	0	0	1	0	1	0	0	0	1	0	0
Attributes in common, 1 & 2	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Distinct attributes, above	0	0	0	1	1	0	1	0	1	1	0	0	1	0	0

With the data thus recorded, the computer can compare each sample with every other sample, and through a series of computations, each directed by a specific set of "orders" (the program), the taxonomic value of each characteristic can be checked, and the samples ordered into groups. Many manipulations are involved before the final "output" from the computer, but the operations are very rapid.

As the program proceeds, one of the first products is a set of correlation coefficients. "Correlation" in this sense indicates the degree of relatedness, or the number of characteristics in common. Obviously, all the cultivars have many characteristics in common, or they could not be classified in one species *(Manihot esculenta)*. One could hardly expect to work with entirely unrelated organisms, or the value of the whole program is lost. It is, therefore, essential that the taxonomist be well versed in his science. He must also be able to select characteristics of the plant that have some significance for his purpose—the classification of a particular group of plants.

Table I shows the way in which the correlation coefficients are derived. For example, two specimens that have fifty per cent of the characteristics in common have a correlation coefficient of 0.500; seventy-five per cent of the characteristics in common, a correlation coefficient of 0.750; and so forth.

Careful selection of appropriate characteristics makes possible the valid use of the correlation coefficients. The correlation coefficients range from near zero for distantly related plants to near one for closely related specimens. The higher the correlation coefficient, the more closely related the plants are. It is possible, after computing the coefficients, to set up a sort of mileage chart as shown on Table II—something like those found on highway maps giving distances between cities. The taxonomist must judge the

TABLE II

SPECIMEN NO.

SPECIMEN NO.	70	289	225	236	154	190
70	1.00	.412	.715	.412	.262	.352
289	.412	1.00	.412	.333	.600	.262
225	.715	.412	1.00	.333	.333	.500
236	.412	.333	.333	1.00	.200	.262
154	.262	.600	.333	.200	1.00	.333
190	.352	.262	.500	.262	.333	1.00

Portions of matrix—the "mileage chart" of coefficients.

significance of his correlation coefficients in establishing a sound classification. For example, it is possible to say that all plants with a correlation coefficient arbitrarily established at .785 or higher should be considered as one species, one variety, or other taxon. Coefficients lower than .785 indicate lower degrees of relationship. We have employed techniques to remove some of the arbitrariness from the selection of the cut-off point, but the individual's judgment still plays a major role in establishing satisfactory limits.

Such an operation as this is not entirely automatic. There is, and should be, the judgment of the value of the work by the most significant single factor in the operation—the taxonomist. However, the judgment possible as a result of the computer program is much better because of the large storage capacity, the speed of the machine, and its precision in operation; also the making of decisions need not be so long delayed. The program also enables us to quantify our decisions and thus to remove one of the criticisms of the discipline.

Our program differs from Sneath's or Michener's and Sokal's in several technical ways, but these differences are not great, and there is little controversy about them. Each one developed his program without much knowledge that the others were working on the same lines. The fact that each had worked on widely different groups of organisms perhaps contributed to the former isolation.

The implications of computer application to taxonomic problems are numerous and quite exciting. Many former problems that involved such vast quantities of data that they seemed impossible to solve now come within the grasp of the taxonomist. Systematic studies of the tremendous variation in most cultivated plants can now be handled in periods that allow an individual to encompass the complexities of a group of cultivars. Previously one man might spend a lifetime in the process, and then only achieve partial goals. For example, the vast numbers of wheat varieties can now be more easily studied, using all the data available from the world literature, from present sources, and incorporating new bits of information as scientists gather it. Floristic studies, long the major output of the taxonomists of The New York Botanical Garden, can be greatly facilitated by using the storage capacity of the computers to put into order information that is now extremely laboriously correlated. Tropical floras, at best only just begun, should be helped tremendously by utilizing the storage and correlative capacities inherent in the electronic computers.

We hope in the near future to begin work on studies of marine algae, taking presently published monographs of marine algae and incorporating these into computer storage. Perhaps we shall be able to assist oceanographers, whose rapidly accumulating samples of marine plant life threaten to sink their program because of their inability at present to get the material properly classified.

These are some samples of possible actions with the help of the electronic computers. At the moment, we must buy or borrow time on computers that are owned or rented by much larger organizations than The New York Botanical Garden. This is hardly the ideal set-up, and one that may some day be overcome. Two stumbling-blocks are in the way, common complaints that are heard in many fields: first, a shortage of well-trained taxonomists, particularly those who are capable of using the computers to their best advantage; and second, a shortage of funds to attack the problems with the computers. Though the expense seems staggering, the increased knowledge and improved taxonomy will greatly overpay the costs.

THE BOERNER BOTANICAL GARDENS

By JOHN E. VOIGHT

Mr. Voight is Superintendent of the Boerner Botanical Gardens, Hales Corners, Wisconsin, and President of the American Association of Botanical Gardens and Arboretums.

THE MUNICIPALLY operated Boerner Botanical Gardens were established as the result of a consistent adherence to an ideal. About 1927, when the area was still in farmland, Charles B. Whitnall, frequently referred to as the "father of the Milwaukee County Park System," became interested in securing the land for a large rural park. He frequently visited the place with the late Alfred L. Boerner, at that time County Landscape Architect. It became Mr. Boerner's dream that a portion of this picturesque land should be devoted to the development of a botanical garden, and when this was actually accomplished, the garden was named after him [in October, 1958]. Working together, and with the support of dedicated park commissioners in 1929, he and Mr. Whitnall succeeded in arranging for the acquisition of six hundred and fifty-five acres, ten miles southwest of downtown Milwaukee. The north portion was set aside for the development of a botanical garden.

In 1934, the Federal Government developed a "green belt" housing project adjoining Whitnall Park and dedicated fourteen hundred acres to Milwaukee County for public park and parkway purposes. This land, known today as the Root River Parkway, functions as an addition to Whitnall Park, making a total combined ownership of two thousand, six hundred and fifty-five acres.

Whitnall Park is a superb piece of typical Wisconsin terrain. Through it flow two spring-fed brooks which are bounded on either side by wooded hillsides. Many different habitats are available for plants—without much searching a situation can be found for even the most exacting plant. The major development was accomplished through various Federal Works Projects, including the Civil Conservation Corps, the Works Project Administration, and the National Youth Administration, during the years 1930-1940.

The Boerner Botanical Gardens are easily accessible from several of Milwaukee County's traffic arteries and by public transportation. They are open to the public seven days a week, from 7:30 a.m. to sunset. There is no admission charge.

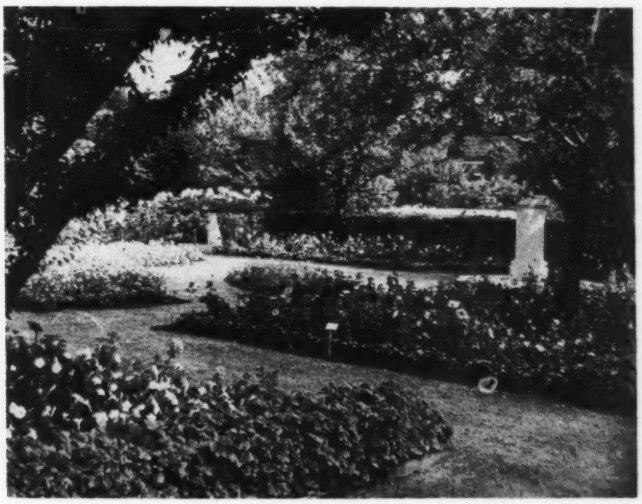
The Gardens are divided and subdivided into unique units of floral groups and displays. These include annuals, perennials, herbaceous and tree peonies, irises, day-lilies, bulbs, hardy asters, phlox, hardy lilies, chrysanthemums, roses, rock and alpine plants, herbs, and others.

In the walled garden colorful flowers, trees, shrubs, hedges, groundcovers, and water features have been artfully combined to create an inspiring effect. Over sixteen thousand annuals are required for this spectacular unit, which represents the main entrance to the Botanical Gardens. Unsuspecting visitors who wander in casually are pleasantly surprised by the diversity and quality of the plant materials. It is here that examples of floral composition for mass effect, for color, for texture of foliage, and for flower and foliage combination may be observed and studied. In a shaded spot there are groupings of approximately seven hundred tuberous-rooted begonias.

The west mall presents a colorful, ever-changing garden

Left. View into the rose garden from the vine-clad arbor.

Below. Over sixteen thousand annuals are raised for display in the walled garden.



picture of interesting perennials, and it has been most successful in stimulating an interest in perennial gardens. The south mall contains tree peonies, phlox, hardy lilies, delphiniums, hardy asters, and chrysanthemums. Appropriate shrubs and trees furnish an attractive background.

The rock garden simulates a natural limestone out-cropping. Here grow the alpine and other suitable rock garden plants, with specific shrubs and trees that like the situations afforded by the man-made rock ledges.

The rose garden is without doubt the most popular of all the garden units. Its display of fine varieties, grown to perfection, have quickened the desire in visitors to grow good roses in their own gardens. The plantings contain about five thousand plants of three hundred varieties of hybrid teas, floribundas, grandifloras, climbers, hybrid perpetuals, and species. The Boerner Botanical Gardens aim to show the finest of the new and a worth-while representation of the older, still unsurpassed varieties.

The herb garden, the newest unit and established in 1956, comprises a fascinating display of aromatic, culinary, and medicinal plants. There are over two hundred species and varieties of herbaceous plants, and forty species of trees and shrubs of herbal value. One of the features that has helped to make the herb garden more interesting and educational is the method of labeling. Each plant is labeled attractively and legibly, not only with the botanical and common names, but frequently with the foreign names (French, Italian, German, Polish, and so on). These names are often more familiar to older generations.

The day-lily garden, located west of the south mall, has served well in guiding garden enthusiasts to grow this "flower with a future." The numerous varieties are displayed on a side hill that provides an excellent location for growing and evaluating them.

The spectacular peony garden, located west of the Administration Building, contains one hundred and seventy-five varieties—the outstanding new ones as well as the best of the older ones. This garden always attracts thousands of visitors when it is at the peak of bloom during the last week in June. Another noteworthy collection consists of ninety-five varieties of tree peonies. It creates an annual

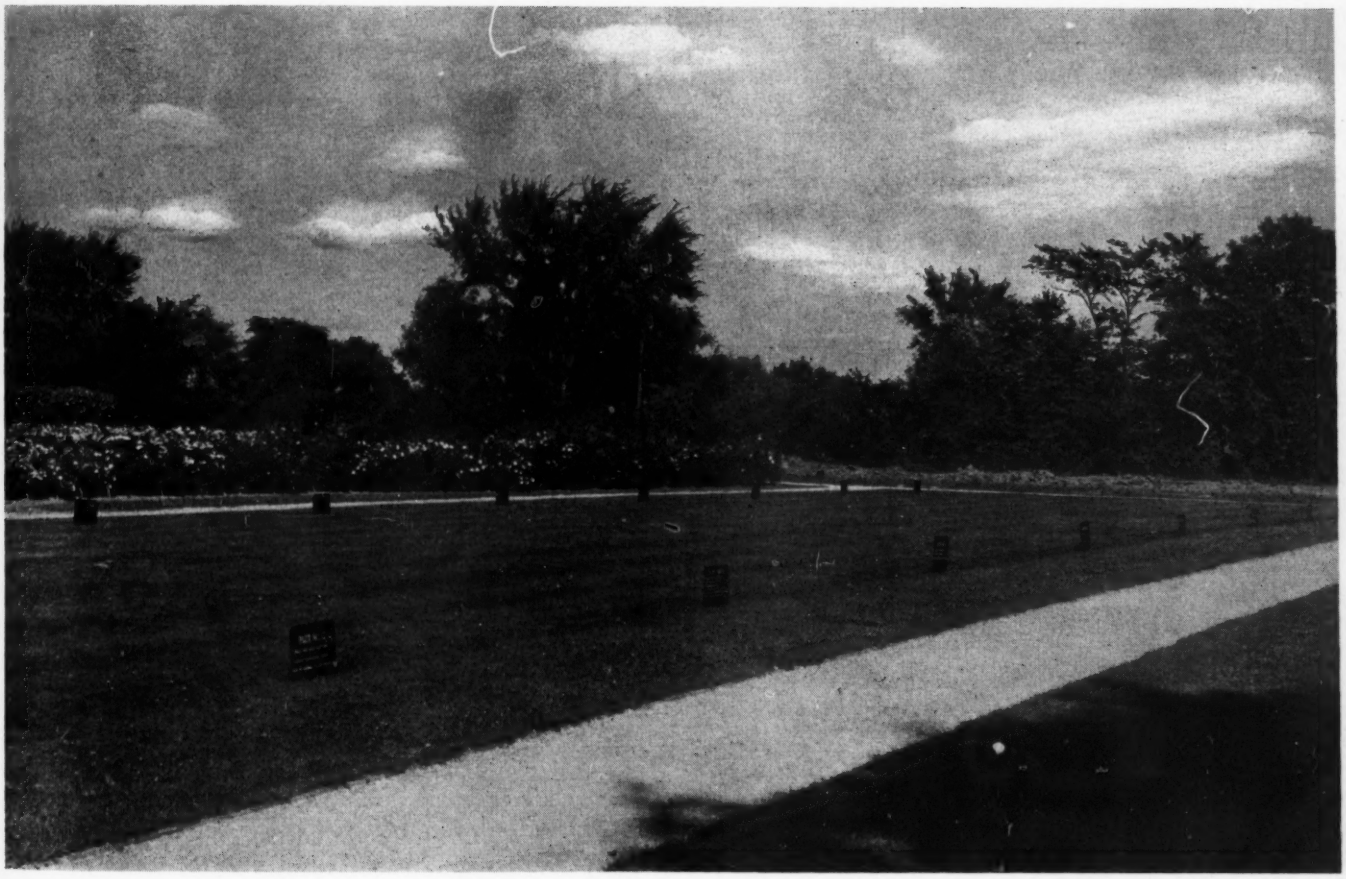
SWEET BASIL
OCIMUM BASILICUM
FRENCH : BASILIE, HERBE ROYALE
ITALIAN : BASILICO
GERMAN : BASILIE, KONIGSKRAUT
ANNUAL CULINARY HERB
USES : FLAVORING MEAT, FISH, ECC.
TI, VEGETABLE JUICES & FRUIT BEVERAGES
TED BY SEED & ALSO GROWN AS ORNAMENTAL

The herb garden contains herbaceous plants, shrubs, and trees of aromatic, culinary, and medicinal value.

Right. One of the educational labels in the herb garden.

There are seven hundred trees, representing one hundred and seventy-five species and varieties, in the flowering crab-apple collection.

The lawn test plots are one of the important services for the public at the Boerner Botanical Gardens.



The Administration Building of the Boerner Botanical Gardens.

stir among the visiting public and has done much to awaken interest in growing these majestic flowers in the Milwaukee area.

The trial garden, devoted to annuals, roses, mums, dahlias, gladiolus, hardy lilies, dwarf fruit trees, ornamental trees and shrubs, and lawn test plots is gaining reputation as one of the nation's top public gardens in such services. It is one of the official test gardens, scattered throughout the country, where roses and mums are grown and judged for All-America Selections.

The collection of some forty thousand tulips, representing two hundred and seventy-five varieties, delights visitors with its beauty; at the same time it demonstrates how tulips should be grown and used in the landscape. All the known types and colors are represented, and all are legibly labeled.

Each year has been a steady advance in the development of the collection of woody plants. The picturesque natural woodlands provide an excellent background for the plantings. A careful selection in the arrangement of trees and shrubs has facilitated a composition by comparison. The selection also enables a general estimate to be made of their value for ornamental use. Great strides have been made in starting major permanent collections of flowering crab-apples, lilacs, maples, oaks, locusts, spruces, cedars, yews, junipers, pines, willows, ash, birch, hawthorns, viburnums, cotoneasters, euonymus, and others. Each collection has been designed for its landscape effectiveness as well as its usefulness in the study of plant material. A great deal of thought, time, and effort have been expended on the labels. As the plants become large enough, engraved plastic, wood, or metal labels are attached to them. The text is prepared with the utmost care; it affords accurate data for the student as well as descriptive information for the lay visitor.

The Administration Building accommodates the lecture room, exhibit area, horticultural reference library, herbarium, and offices. It is interesting to observe the wood carvings in this building, as well as the furniture and fireplace mantel in the library. All were produced under the Federal Works Project in 1936.

Recognizing the need for organized nature study, the Boerner Botanical Gardens inaugurated the "Nature Program." This resulted in three trails: nature, hiking, and evergreen. These trails wind through picturesque natural and man-made park and parkway areas, interesting throughout the four seasons of the year. Each trail has numbered rustic posts to correspond with illustrated guide booklets; these are available at a small charge. The booklets are designed primarily for people without technical training.

A series of lectures and guided tours are offered to garden and nature-study groups. Outdoor garden clinics are conducted to acquaint amateur gardeners with authoritative garden information. School classes, 4-H clubs, and Scout troops are encouraged to visit the Boerner Botanical Gardens frequently for instruction and inspiration. These popular programs are well attended. The local radio and TV

stations and the newspapers are most cooperative in publicizing programs and in publishing information.

Continuous public service on garden and plant information is rendered by telephone, mail, literature and personal contact. A good supply of salable educational items—books, periodicals, games, and the like—is available in the Administration Building.

This significant institution in Whitnall Park has created a garden-minded community of people from all walks of life. It has awakened the average home owner to the vast possibilities of making his home grounds a place of beauty. It will ultimately become the nucleus of a more beautiful, cultural metropolitan area. Over a million people visit the Boerner Botanical Gardens annually, indicating to the Milwaukee County Park Commission that they are fulfilling a good public service.

AWAKENING AN INTEREST IN THE NATURAL SCIENCES

PUTTING LIFE into the study of living things was the goal of the Biology Seminar held during the past summer at the New Providence, New Jersey, High School. Twenty students registered for a course that gave no credits towards the high school diploma, but did give them a better understanding and appreciation of the world of nature through first-hand observation rather than through textbooks or preserved specimens. The seminar was held one day (all day) a week for ten weeks with each day devoted to a different area of biology. The only prerequisites to participation in the seminar were one year of biology and an interest in learning more.

The schedule included laboratory sessions on instruments, as well as discussion of aims and organization; on embryology; on comparative chordate anatomy with emphasis on primitive chordates; and on the students' special projects. Biological films were shown one day. Field trips were taken to the wild-flower trail in Jockey Hollow National Park; to nature trails in Watchung Reservation; to Longwood Gardens; to Stokes State Forest, and to Island Beach State Park.

The field trips represented a variety of biological environments. Each area was studied systematically by the seminar students in study groups of two or three, with each study group concentrating on a certain area as trees, wild flowers, protozoa, algae, fresh-water plankton, birds, ferns, macroscopic water animals, and nature photography.

The first field trip—to the wild-flower trail in Jockey Hollow—was an "eye-opener" for the students, since they began to realize for the first time exactly how fascinating nature study can be. The group moved at a leisurely pace through the trails and stopped frequently to examine more closely or to "key out" particular plant specimens. The wild-flower group was able to collect about twenty specimens (not from the wild-flower trail) for their herbarium, which were just enough to whet their appetites for future trips. This trip was kept short (two hours on the trail) intentionally to insure a sharpening of interest rather than a dulling that might have resulted with this age-group if the hike had been long. The class returned to the laboratory to complete the work of classifying, mounting, printing leaves, and so on.

The second field trip took the seminar students to nearby Watchung Reservation for a five-mile hike under the leadership of Dr. Harold N. Moldenke, Director of Trailside Museum. Under the excellent tutelage of Dr. Moldenke, they added forty-nine wild flowers to their herbarium, as well as many new trees (leaf prints), and sighted birds new to them. Most rewarding of all was the introduction of the class to such a remarkable biological area less than three miles from their school. They saw with their own eyes how rich it is in zoological as well as botanical specimens. Dr. Moldenke set a rapid pace in order to show as many areas as possible in the time allotted, so there was no time for close examination on the trail; but specimens were collected by him for the students to study upon their return to the laboratory.

The remaining trips to Island Beach, Longwood Gardens, and Stokes State Forest afforded hours of adventure in the world of nature for this group of teen-agers.

During the regular school year the Biology Club conducts similar studies. Field trips for this particular group included Longwood Gardens (during Christmas vacation), Ciba Pharmaceutical's research laboratory, and the Great Swamp in Morris County during warbler migrations.

Much of the credit for this Biology Seminar must go to the students who are truly learning for the sake of learning. The only rewards are what they derive from their efforts. Credit must also go to the Board of Education of New Providence, New Jersey, for its permission and support for this experiment in education.

It has been a successful experiment—the enthusiasm of

Robert G. Gorton, instructor, and a student collect freshwater plankton and search Seeley's Pond for bullfrog tadpoles for experiments in development.

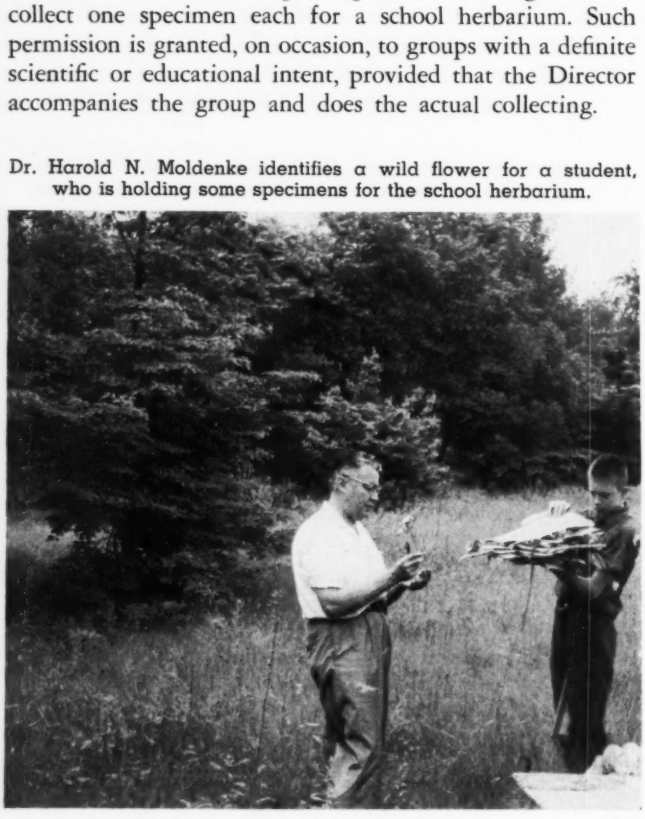
the students carried through to the end of the seminar. Mr. Gorton recorded the seminar on 35 mm. kodachromes so that the experiment could be shared with other schools and groups interested in initiating similar seminars. Such seminars may create a life-time interest in one of the natural sciences as a hobby or may lead to the choice of a career in biology—botany, zoology, or ornithology.

ALONG NATURE TRAILS IN THE WATCHUNG RESERVATION

On July 19, 1961, eleven students of the New Providence, New Jersey, High School arrived at the Trailside Museum in the Watchung Reservation with their instructor, Robert G. Gorton, Chairman of the Science Department. In making the reservation with Dr. Harold N. Moldenke, the Museum's Director—and such a reservation, because of the great number of groups, must usually be made in writing three to five months in advance—Mr. Gorton had requested that the formal two-hour program be replaced by a more informal nature walk along some of the area's many trails. Normally, a group is given a twenty-minute lecture, profusely illustrated by colored slides, on local plants and animals, or on any other nature topic which the leader requests. This is followed by a forty-minute guided tour of the Museum's exhibits, a twenty-minute visit to the zoo, and a forty-minute walk on one of the three marked nature trails. But for this particular group of students three hours were spent on narrow trails which wind through woods and fields, along brooks and quiet ponds, and by grassy meadows and roadsides.

Collecting any plant, animal, or geologic material in the two-thousand-acre reservation is strictly forbidden for obvious reasons. However, special permission was granted to collect one specimen each for a school herbarium. Such permission is granted, on occasion, to groups with a definite scientific or educational intent, provided that the Director accompanies the group and does the actual collecting.

Dr. Harold N. Moldenke identifies a wild flower for a student, who is holding some specimens for the school herbarium.



The group did not follow the regular nature trails along which classes of all ages are conducted up to four times daily by the Director and his educational assistant, Irma H. Heyer, a retired school principal from Elizabeth, New Jersey. On these trails collecting is never permitted. Instead, the group traversed some of the many hiking and bridle trails and returned along the margin of an automobile road, covering in all perhaps five miles.

About one hundred and fifty species of native and introduced trees, shrubs, vines, herbs, and fungi were observed, and a number of birds and mammals were identified by sight or their call, as well as scores of insects and their homes. Among the trees were tulip-tree, red, black, white, swamp white, pin, and rock oaks, American and hop hornbeams, red-cedar, Canada hemlock, red, white, and pitch pines, red, silver, sugar, and black maples, box-elder, pignut, butternut, black walnut, osage-orange, sassafras, American and slippery elms, flowering dogwood, sweet and wild black cherries, and sour gum.

In a clearing near the burial ground of the old "Deserted Village," whose history dates back to the seventeenth century, Dr. Moldenke pointed out bayberry, huckleberry, deerberry, lady cornel, and highbush blueberry growing among the Indian grass and bearded brome grass, used by the early settlers. Several species of huckleberry, blueberry, dewberry, blackberry, and raspberry were seen in abundance, as well as the bird-introduced wineberry, oriental bittersweet, and Morrow bush-honeysuckle.

Some of the students were "thrilled" to see for the first time silver poplars, and the ancient European lindens that had been introduced before the Civil War by "King David" Felt in the village that he ruled like a monarch of old. They were also interested in the Chinese tree-of-heaven that was introduced at a later date to serve as host for the ailanthus silk moth, now our largest moth. Others were fascinated by the colonies of Indian-pipes which were poking up through the leafmold in secluded groves and by the magnificent orange butterflyweed which enlivened several sunny fields. Korean bush-clover stood like sentinels in the same field or, more aptly, like stiffly advancing soldiers about to take over the area. A belated yellow flag was still blooming in the brook running through the Drake's Fields which are a mecca of all bird-watchers in the region.

Dr. Moldenke gave the students the scientific and common names for every species seen and also enlivened the walk with stories about the plants and animals from mythology, folk lore, and history. He spoke of the drops of "princess blood" on the velvety leaves of jumpseed, the feeding of loosestrife to oxen in early times to make them lose their tendency to strife, and of the "machine guns" on the witch-hazel and the use that school children often make of them. He told of the excellent "swords" and "spears" that children make of blue wild-lettuce stems in winter, of the arrow-wood or dockmackie of the Delawares, and of the "dolls'-eyes" ripening on the white baneberry stalks. The differences between poisonous and non-poisonous sumacs were brought to the students' attention, and the deadly water-hemlock compared with the edible sweet-cicely.

(Continued on page 224)

PLANT-ANIMALS AS EXPERIMENTAL TOOLS FOR GROWTH STUDIES

By S. H. HUTNER

Dr. Hutner, Associate Research Director of Haskins Laboratories, discussed this subject at the symposium on "Fundamental Developments in Plant Growth" sponsored by the Torrey Botanical Club and AAAS Section G at the December, 1960, meeting in New York City of the American Association for the Advancement of Science.

SOME PROTISTS,* like the hardy, fast-swimming, deep olive-green, photosynthetic, voracious chrysomonad flagellate *Ochromonas danica,* combine the decisive attributes of plant and animal. Most textbook discussions of plant versus animal are fogged by timidity, when protists rather than oaks and elephants are discussed. Even the most zoophobic misanthrope of botanists must concede that in comprehending what "plant" means, insight about animality helps. No less must the student of animality appreciate the plant origins of many of the devices uniquely animal, for example, vision.

In 1876 Huxley defined animals as eaters. In 1954 Haldane described animals as wanderers seeking fuel and ready-made spare parts—if one adds "characteristically ingested in chunks," he has a workable primary definition. Electron-microscope and isotope-tracer experiments emphasize that the talent underlying eating is appreciable synthesis of food-vacuole membrane. Organisms unable to do this are plants. They have other specializations: photosynthesis, the elaboration of external digestive enzymes as in heterotrophic bacteria and fungi that obtain nourishment from decaying matter, or efficient systems for using dissolved nutrients. Since *Ochromonas danica* can live by photosynthesis, with all its carbon coming from CO_2 except for those traces represented by its requirements for thiamine and biotin, it can live as a plant. It also can live in the dark on particles, that is, as an animal. Rather than set up a kingdom Protista and say "animal-like" or "plant-like," it seems better to call *O. danica* and similar protists plant-animals, which accords with their experimental uses. The investigator chooses whether his problem is of zoological, botanical, protistological, or protozoological interest; the organism does not care.

This paper outlines some ways in which these plant-animals are uniquely suited for investigating otherwise hardly accessible processes in plant and animal growth. We may thus see deeper into *plant* and *animal.*

EXPERIMENTAL ADVANTAGES OF GLUTTONOUS PLANT-ANIMALS

Ochromonas danica has an enormous capacity to digest prey. I have watched a few individuals in a hanging drop gorge on dense populations of *Escherichia coli* [the colon bacterium], nearly wiping out the bacteria while multiplying prodigiously. That ingested bacteria can be nutritionally effective was shown earlier in a subtler way: *O. danica* satisfied its biotin requirement when fed bodies of *Thiobacillus thioparus,* whose biotin was presumably all bound since it was unavailable to a biotin-requiring coccus.

Ochromonas danica, a glutton, must, like humans in the hunting stage of social development, gorge when it can to prepare for lean times ahead. In gorging, it must cope with surges of fuel and building blocks. What happens when *O. danica* is given all the simple building blocks and fuel it can handle, that is, allowed a sustained gorge? This question is not simple; exploded hypotheses clutter our notebooks. Unexpectedly, at high concentrations of superior substrates, for example, the combination of glycerol and propylene glycol, growth increases sharply but nutrient imbalances appear. At lower concentrations of substrates such imbalances do not hinder growth. The additional growth requirements induced in *O. danica* by incubation at elevated temperatures resembled those induced by media containing excess methionine. We now think that the common denominator in these "metabolic stress" experiments is a speeding-up of growth which exaggerates the demands for certain nutrients, notably certain trace elements and vitamins, and induces lethal imbalances in utilizing amino-acid. And, under still greater stress, imbalances develop in the utilization of as yet unidentified lipids.

The *O. danica* results are now outrunning the literature on rat and chick nutrition which guided our early experiments. The appearance of amino-acid requirements under the stress of greatly speeded growth seemingly has its counterpart in the chick, whose high body-temperature (40-42° contrasted with our 37°) and rapid growth cause it to outstrip its capacity to synthesize such "unessential" amino acids as glycine and arginine. Also the appearance of a B_{12} requirement when *O. danica* was given excess methionine + glycine along with certain supplementary nutrients may, in view of the multiple interconnections between B_{12} and folic-acid synthesis and function, have its counterpart in the enhanced folic requirement of chicks fed excess glycine. The enhanced B_{12} requirements in animals given thyro-active materials and in *Ochromonas malhamensis* grown at elevated temperatures fit into place as consequences of speeded growth.

Vertebrates, including humans, treated with thyro-active substances, have enhanced nutritional requirements besides that for B_{12}. These nutrients have not yet been identified for the rat; likewise, supportive diets for thyrotoxic patients are primitive.

Extensive damage in higher animals is followed by a wasting of skeletal muscle and negative nitrogen balance, which is not alleviated by ordinary high-caloric or high-protein diets. This process is controlled by the anti-shock cortical hormones. If in emergencies higher animals do fall back upon an ordinarily inconspicuous metabolic pathway to make ready fuel and repair parts, centering around certain amino acids and related compounds, comparison of

*Protista, or protists, are, in general, microscopic living beings, both plant and animal.

metabolic stress in higher animals and protozoa may reveal a common denominator. It becomes of evolutionary and taxonomic interest to look for corresponding systems imbedded in different plant lines. This emergency system may include one or another of the newly discovered metabolic cycles in which vitamin B_{12} figures.

Experiments with fast-growing ciliates indicate that efficient substrates can be overlooked because while giving growth an immediate impetus, essential syntheses lag, especially of amino acids and of vitamins and other co-factors for metabolizing these substrates directly or for preliminary conversions into metabolizable forms. Paradoxically, then, rapid growth may lead to poor growth. Metabolic stresses can be alleviated—and so identified—in organisms amply permeable to nutrients that relieve these strains. Otherwise one sees an irremediable lethal condition. Complicated amino-acid balances are not new in plant-tissue culture. One wonders how many coconut-milk factors are no more than brittle balances. All "protein" and "peptide" factors have so far in microbiology been resolved into amino-acid balances, sometimes complicated by peculiar trace-metal requirements or trace requirements for fatty acids or sterols.

Dr. William C. Steere, Director of The New York Botanical Garden, has said: "The unifying force of systematics in the fields of botany and zoology gives it a transcendental importance as yet too little recognized." The following is adduced in support:

A characteristic separating green plants and higher fungi from other creatures is their lack of B_{12}. Strict vegetarians come down with a facsimile of pernicious anemia, unless they are lucky in having intestinal bacteria which are good B_{12} producers. One must understand the distinction between *containing* and *requiring* B_{12}, before regarding B_{12} as the thread of Ariadne that leads through the taxonomic labyrinth of the many protistan groups of puzzling position. (How delightful to assign *this* group to the orthodox plant kingdom and *that* one to the main animal lines, just as in Gilbert and Sullivan's *Iolanthe* each child born alive is either a little Liberal or else a little Conservative.) An organism neither containing nor requiring B_{12} should be shown to lack any reaction accelerated by B_{12}. This caution is suggested by *Euglena:* it requires B_{12} and does not contain any, as measured by all available assay organisms such as higher animals, *Euglena* itself, various bacteria, and *Ochromonas malhamensis.* The taxonomic characteristic represented by B_{12} distribution has economic as well as medical importance: plant feeds for farm animals are now supplemented by "animal protein factor," whose main potent ingredient is B_{12}, usually made by special microbial fermentations. The extremely rapid growth and efficient food conversion permitted by these supplements have helped set the stage for investigations on the importance of nutritional balances for efficient growth. Dr. T. H. Jukes of the American Cyanamid Co., is, with his associates, the pioneer in this field.

Ochromonas malhamensis (smaller than *O. danica* and poorly photosynthetic) has a B_{12} requirement exactly like man's and not like *Euglena*'s; the two patterns are quite different. Our faith that the vitaminic resemblance between *Homo* and *Ochromonas* is more than convergence is encouraged by the remarkable parallel recently becoming apparent to us that all the compounds oxidized by higher animals appear to be utilized by *O. danica,* either when tried singly or when sparked by other substrates. Since B_{12} figures conspicuously in stress reactions, any phylogenetic scheme for the different animal lines which lays emphasis on B_{12} patterns needs buttressing by a concordant taxonomy of stress reactions. And so a new taxonomic problem arises: which inducers of stress are the fundamental ones—elevated temperatures, abnormal nutrition, or certain chemotherapeutic agents and herbicides?

ENDOCRINOLOGICAL SEPARATIONS OF PLANT AND ANIMAL

In 1957 Wooley suggested that serotonin may be the counterpart of indoleacetic acid: that in plants, whose sap is acidic, the acidic auxin has evolved; and in animals, where the juices are rather alkaline, the corresponding base serotonin operates and, in some lower vertebrates, tryptamine. All, he thinks, may act by altering permeability to calcium and magnesium.

Here clearly posed is another problem in finding a common denominator between plant and animal.

The hormones of cellular organisms regulate the choices between using materials as building blocks or as fuel—insulin and steroid hormones are striking examples. If in land plants, as elsewhere, *inter*cellular hormones had their origin in *intra*cellular regulators, then a unicellular green alga, if subjected to metabolic stress, might have its capacity to synthesize hormones so heavily drawn upon that its growth might become dependent on exogenous hormones or hormone precursors. Which green plant to try? Such unicellular forms as *Chlamydomonas* or its colorless counterpart *Polytoma* have a very restricted permeability. The photosynthetic pigments of the euglenids are nearly identical with those of green algae. In other molecular respects *Euglena* resembles higher fungi; for instance, it contains ergosterol.

Euglena gracilis is permeable to a fair range of compounds, but it does not ingest particles and so is a poor experimental object as compared with *Ochromonas* or cellular animals for studying nutrition under stress. But the euglenids include many animals of unmistakable euglenoid antecedents. One of them, *Peranema trichophorum,* in pure culture has nutritional requirements which include any of a variety of "plant" sterols (for example, sitosterol, stigmasterol, ergosterol) or "animal" sterols (for example, cholesterol), unsaturated fatty acids, and a wide assortment of water-soluble factors. Its voracity is satisfactory: it can ingest whole small euglenas or cut holes in and suck the juices from larger euglenas. We had found nutritional analysis difficult, because it needs surfaces and had a narrow range of tolerance for fatty factors supplied according to the knowledge of that time (1953). Recent advances in (a) ways of supplying lipid materials; (b) knowledge of amino-acid balances in nutrition; (c) knowledge of the effectiveness of methyl cellulose and the like hydrophilic particles which provide surface and so allow three-dimensional growth in culture vessels; and (d) advances in biochemistry, especially in knowledge of switching points between fuels and biosynthetic intermediates—all urge a thorough study of this animal, especially the pattern of its B_{12} requirement.

"CONTROLS" IN ELUCIDATING GROWTH REGULATORS IN PLANT-ANIMALS

The remorseless logic of the preceding argument leads to the conclusion that the proper studies of botanists who seek to identify the intracellular mode of action of plant hormones are plant-animals like *Ochromonas* and animals like *Peranema*—the more voracious and gluttonous the better. Certainly the impotence of the orthodox botanical approaches to the problem, however valuable once in discovering these hormones, means that other approaches are needed; why not an attempt to outflank from the animal side?

In assigning "plant" and "animal" characteristics to protists, a precept enunciated by an eminent molecular botanist, Dr. D. M. Bonner, might be recalled: a biological experiment cannot have too many controls. For the present purposes this means comparisons with as many kinds of organisms as possible, before we dare conclude that the common denominator between chrysomonads and metazoa is *the* animal metabolic pattern, and that between the euglenoid and other green-pigmented groups is *the* plant pattern. Only a few controls can be mentioned here. One wishes that some of the vast and repetitious effort put into studying the plant hormones had been diverted into analyzing growth regulation in the multicellular brown and red seaweeds, and the many kinds of green algae having multicellular organization. Recent advances in the cultivation of marine algae point to a wide-open field.

Knowledge of the nutrition of other protozoa, notably of ciliates and trypanosomid flagellates,** has advanced to where their metabolism under stress is accessible to analysis. Eventually these, it is expected, will be joined by members of the Acrasiales and other groups having ameboid stages in the life cycle. These might be termed plant-animals but in a different sense, since here the emphasis is on the apposition of ameboid feeding stages with immobile reproductive stages culminating in cyst formation.

The dinoflagellate plant-animal line is beginning to be explored biochemically. The possibilities are exciting, as they include some of the most elaborate of pure animals, for example, *Noctiluca,* as well as photosynthetic forms, with and without abilities to ingest.

PRACTICAL USE OF PLANT-ANIMALS

Determination of B_{12} by *Ochromonas malhamensis* is widely used as a replacement for chick and rat assays; it is the official method in Britain. A new use is developing —screening for anti-cancer agents. Several pharmaceutical firms are employing chrysomonads with some success; details should be published in a year or two.

The patterns of susceptibility to chemotherapeutic agents are in themselves taxonomic characteristics. The manifold distinctions between antibacterial and antiprotozoal drugs throw into relief the many overlappings between antifungal and antiprotozoal agents. Should *Ochromonas* efficiently detect compounds specifically cytotoxic to higher animal cells as compared with green-plant cells or, conversely, should *Peranema* detect compounds specifically herbicidal but harmless to chrysomonads and metazoa, the taxonomic scheme inferred from the present discussion would be supported. If plant-animals should efficiently detect toxicity to metazoan cells, then they might become useful in detecting those herbicides, insecticides, and other agricultural chemicals that present unreasonable hazards to higher animals.

Chlorophyll formation in *Ochromonas danica, O. malhamensis,* and *Euglena gracilis* is inhibited by the herbicide 3-amino-1, 2, 4-triazole; as measured by growth inhibition, *O. danica* and the duckweed *Spirodela oligorhiza* were about equally sensitive. Amino-triazole inhibition of growth and chlorophyll formation in *O. danica* was annulled by iron, in part by cholesterol, and also by adenine but not by riboflavin; the combination of iron and adenine was reported to be very effective. This instance is cited to indicate how convenient *O. danica* is for mode-of-action studies of cytotoxic materials.

Another source of information drawn on for plant-animal studies is the trouble ruminants occasionally have in coping with surges of ketonic acids. Little if any carbohydrate is absorbed by the cow from the contents of its first stomach or rumen; ruminants depend on aliphatic (fatty) acids. Ruminants may have retained—or developed—metabolic pathways not obscured by the usual predominance of carbohydrate utilization. One of the original reasons for trying propylene glycol on *O. danica* was that it corrected ketosis in cattle as well as glucose did. The role of corticoid steroid hormones in accelerating interconversion of carbohydrate and other foodstuffs is dramatically shown by their effectiveness in treating ketosis.

Screening programs are tedious, expensive but inescapable, and so the most information possible should be derived from them. Detection of cytotoxic materials that show differential toxicity as distinguished from general "protoplasmic" poisons point up a situation which has changed from joke to occasional actuality: a cytotoxic material may be a cure; the trick is to find the disease. The range of test systems might embrace viral, bacterial, protozoan, and fungal pathogens; herbicides; and tumors. Dr. Jukes has given examples of how the compounds and concepts of one branch of chemotherapy apply to another. Plant-animals may be versatile tools for identifying the "disease."

I have acted as spokesman for a group of colleagues and students, but they are not to be held responsible for imprudence in leaping at conclusions. The work on plant-animals was aided by grants from the Loomis Institute, the American Cancer Society, and from the National Institutes of Health, the United States Public Health Service.

A particular type of protozoa that attacks the blood of animals, including man, and is usually transferred by a biting insect. For example, **Trypanosoma brucei, which infests the blood of horses and cattle, is conveyed by the tsetsefly, while **T. gambliense** is conveyed by another fly or mosquito into the human blood stream and causes sleeping sickness.

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PRESERVATION OF OUR WILD FLOWERS

By MARTHA COMPTON

Mrs. Compton has been an enthusiastic gardener for twenty-five years, has lectured on gardening and on conservation and wild-flower preservation, and contributed to a number of horticultural publications on these subjects. The weekly column, "Life in the Country," which she conducted for five years, is being prepared for publication as a book by Rand McNally. Mrs. Compton is active in garden club affairs in her state of Illinois, particularly in conservation, and in civic planning and planting.

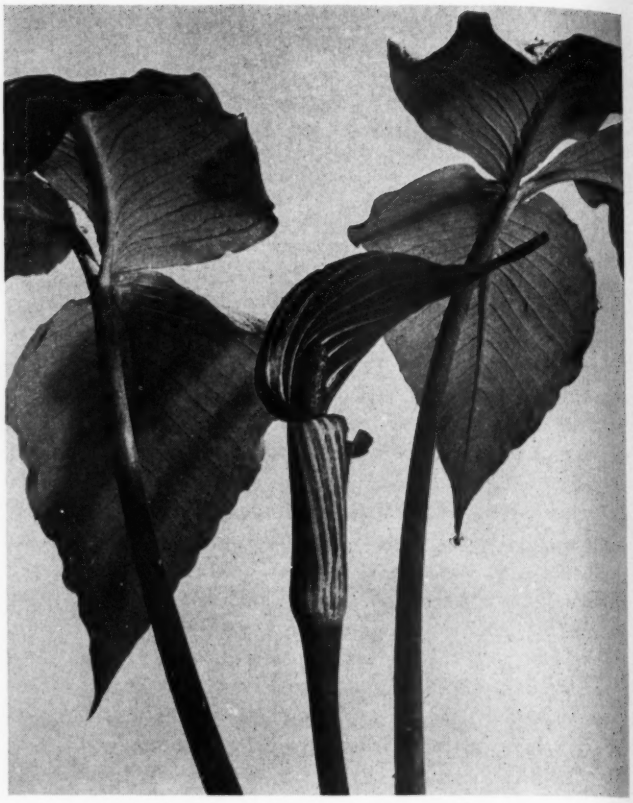
WHILE THE SAVING of our wild flowers may seem to be a very small part of the large over-all conservation program, to the flower lover and to the naturalist it is an important part. The individual is apt to feel helpless in the face of such a tremendous project, but there are ways in which individuals can help to save wild flowers from extinction.

A superb effort is being put forth by arboretums, botanical gardens, and special gardens across the country in establishing and maintaining wild flower "walks" or trails or small areas, where wild flowers are within easy access to be seen and enjoyed and are well marked. These institutions welcome our interest in and support of their efforts along this line.

Another fine effort is being made by the garden clubs, both state and local. These clubs realize that it is up to them to take active measures for the protection of our wild flowers. With the permission of the proper authorities, garden clubs are planting in forest preserves, in local woody tracts, and in public parks the wild flowers that are found growing in their particular communities. Here again the plants are clearly labeled; sometimes a neat and attractive fence encloses the planting, and a rustic bench is placed nearby. Those of us who are members of garden clubs participate in their conservation projects.

The third is definitely a "do-it-yourself" project. Many gardens or suburban backyards have a small corner, perhaps part of it partially shaded, where a few favorite wildings can be grown. A number of these plants are easily cultivated. It is a delight to have them close at hand to observe and study—at the same time to help, in some small way, to conserve our heritage of wild flowers for coming generations.

It is well to plan in advance before you start to make a wild-flower or native-plant garden. For your initial venture, I suggest that you select plants that are not particular about sun or shade or soil, and that grow naturally in your locality. If you refer to one or more of the excellent books on wild flowers*, you will learn that many grow over a great part of this country, others are regional, and some quite local in their range. The old-fashioned "butter and eggs" *(Linaria vulgaris)* roams over a wide area. Actually,



Jack-in-the-pulpit *(Arisaema triphyllum)*

this is not a native but a plant from abroad that has become naturalized in North America; it is native to parts of Europe and Asia. *L. vulgaris* grows in sunny places. Blue chicory *(Cichorium intybus)* is another European plant that has become extensively naturalized in northern North America. This perennial with azure-blue flowers is found in sandy soil along sunny roadsides. A wild flower with an extensive eastern range is *Rudbeckia hirta.* It is seen in meadows, along roadways, and at the edge of woods from Ontario to Florida and Texas, in dry sandy soil, in clayey soil, and in moist humus soil. The handsome false hellebore *(Veratrum viride)* grows in the wild from New Brunswick, Canada, westward to Minnesota and southward to Georgia. It likes cool, moist shade. Solomon's seal *(Polygonatum biflorum)* and false Solomon's seal *(Smilacina racemosa)* are found in half-shady situations and usually in moist soil.

As you progress with your wild-flower garden, you will want to grow some of the choice, difficult-to-grow native plants: the pink and the yellow lady-slippers *(Cypripedium acaule* and *C. pubescens),* the double, and rare, bloodroot *(Sanguinaria canadensis fl. pl.),* trailing arbutus *(Epigaea repens),* and Oconee-bells *(Shortia galacifolia).* These plants require special attention as to soil and location. Some people are successful in growing them for a number of years; in other gardens they fail within a few years. You will also want trilliums. *T. grandiflorum,* one of the best for the wild-flower garden, is easily grown; *T. undulatum,* painted lady or wake-robin, is one of the most beautiful, but more difficult to establish than *T. grandiflorum* and some of the other species.

It is best to obtain plants from a nursery specializing

*BOOKS ON NATIVE WILD FLOWERS

House, Homer D. **Wild Flowers,** Macmillan Co.
Hylander, Clarence J. **Macmillan Wild Flower Book.** Macmillan Co.
Kieran, John. **Introduction to Wild Flowers.** (Hanover House) Doubleday and Co.
Lemmon, Robert S. and Charles C. Johnson. **Wildflowers of North America in Fall Color.** (Hanover House) Doubleday and Co.
Mathews, F. S. **Field Book of American Wild Flowers.** G. P. Putnam's Sons.
Steffek, Edwin F. **Wild Flowers and How to Grow Them.** Crown Publishers.
Swain, Suzan N. **Plants of Woodland and Wayside.** Doubleday and Co.

Black-eyed Susan *(Rudbeckia hirta).*

Virginia cowslip *(Mertensia virginica)*

in wild flowers or native plants. There are several reliable ones. The species or variety will be true to name, and the root growth will be superior to that which is dug from the woods or meadows. *If, however, you have been granted permission* to dig plants from their natural growing place, take care to dig very carefully, to remove whenever possible only a portion of the plant, and to let enough remain for future increase. Cover the remaining roots with soil and tamp it down, so the plant is left in reasonably good shape. Wrap the part that you dug up in wet newspaper, and plant it as quickly as possible. Keep the new planting moist, not wet, until it is well established; and pull out the weeds for the first year or two. After that, the wild flowers should crowd out any undesirable weeds.

To begin your planting with the spring cycle, there are the hepaticas *(H. acutifolia* and *H. triloba),* sometimes called liverwort, blue anemone, and Mayflower. (The correct botanical name of *H. triloba* is *H. nobilis;* but it is still given as *H. triloba* in the listings of wild-flower specialists.) Hepaticas bloom early, even in snow, and are easy to transplant and also to propagate by division. They are occasionally planted in the perennial border where the leaves, three-lobed, light green in spring, dark green in autumn, and of good texture, add a distinctive touch. The delicate flowers, borne on silky-hairy stems, may be lavender-blue, white, or even rose-pink. *H. acutifolia* and *H. triloba* do best in shadier spots of the wild-flower garden in rich woodsy soil that is not too acid.

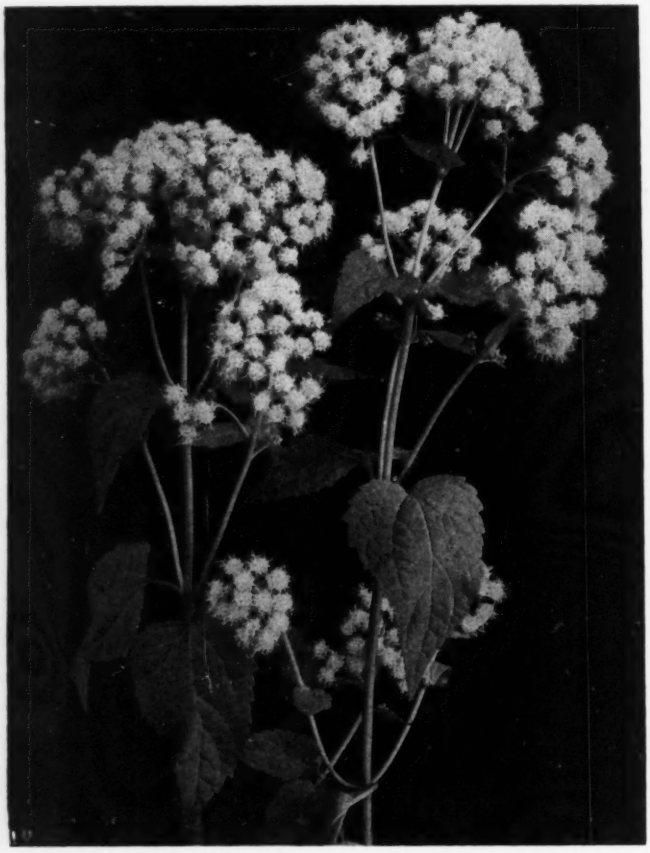
Jacob's ladder *(Polemonium reptans),* whose lovely bell-like flowers are blue, the blue of the sky, also blooms in early spring. This plant has defied yearly mowing on a nearby country road. It is a happy selection for the wild-flower garden, for its narrow lance-shaped leaflets are attractive through the summer. (I have grown Jacob's ladder, too, as a fine house plant.)

At this time the greater celandine *(Chelidonium majus)* is also in flower; and the yellow of its poppy-like flowers is a pleasing color contrast to the blue flower of Jacob's ladder. *C. majus* is excellent for the wild-flower garden, for it has a long flowering period. Its leaf is a beautiful gray-green and deeply lobed. The greater celandine likes sun, but it does grow in shaded woods. This is a naturalized eastern North American plant, having escaped from old gardens. An old saying about this member of the poppy family, taken from a garden book over a hundred years old, is interesting ". . . it beginneth to spring and flower at the coming of the swallow . . . and withereth at their return."

Jack-in-the-pulpit *(Arisaema triphyllum),* a plant that recalls the pleasures of childhood, is a good subject for the native-plant garden. From the moment of its first showing in early spring until fall it is conspicuous because of the hood, or spathe, green more or less striped with purple, that arches over the columnar organ, or spadix, on which are borne the minute flowers. The pistillate or female flowers become brilliant red, fleshy fruits.

Blue chicory *(Cichorium intybus)*

White snakeroot *(Eupatorium rugosum)*.



False hellebore *(Veratrum viride)* is a stunning, strong plant with large ribbed leaves that have the odd appearance of being pleated and are most decorative in flower arrangements. The flowers, carried in long branching clusters, are often listed as "green" and are not remarkable, but the foliage alone makes *V. viride* a worth-while addition to the wild garden. It should be noted that the thick rootstocks are very poisonous. This plant is found in moist situations on the eastern shores of our country and will be protected by law when the Cape Cod area is made a National Park.

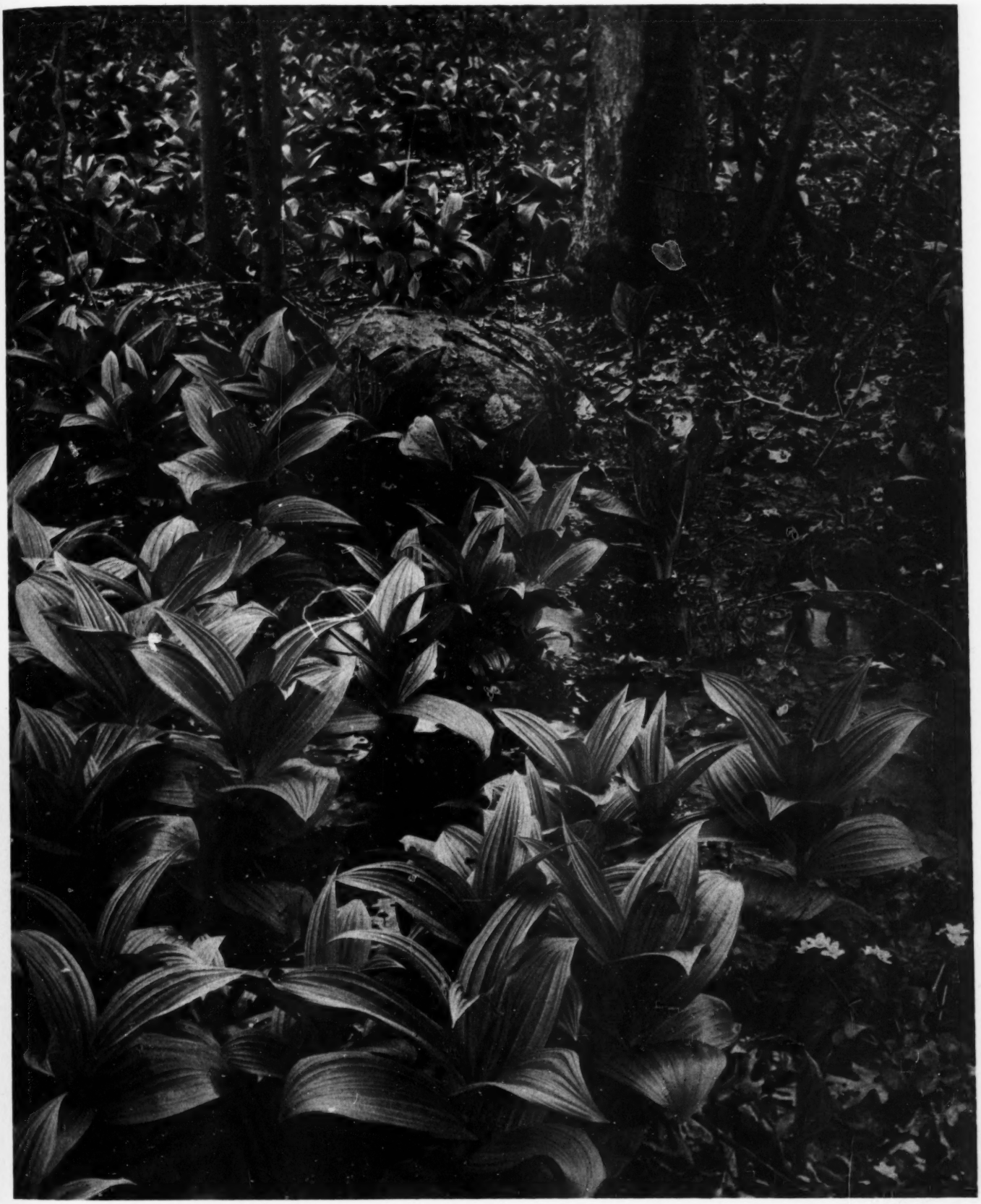
Two members of the heath family—one trailing arbutus *(Epigaea repens)*, protected, but almost too late, the other, wintergreen *(Gaultheria procumbens)*—are very difficult to grow, but it is worth the effort to cater to their requirements. The soil must be acid, sandy, and well drained, yet contain leafmold, and the location must be partially shady. This wintergreen is not to be confused with the flowering wintergreen, or gay-wings *(Polygala paucifolia)*, mentioned by Thoreau and still growing at Walden Pond; in fact, it is increasing there. Fortunately, the stand of this interesting native plant is known only to the conservationists who are protecting all the Walden Pond area. Wintergreen *(G. procumbens)* is a very slow grower; in my garden where it has been planted for several years, I see no appreciable growth. Perhaps it is not in the right location.

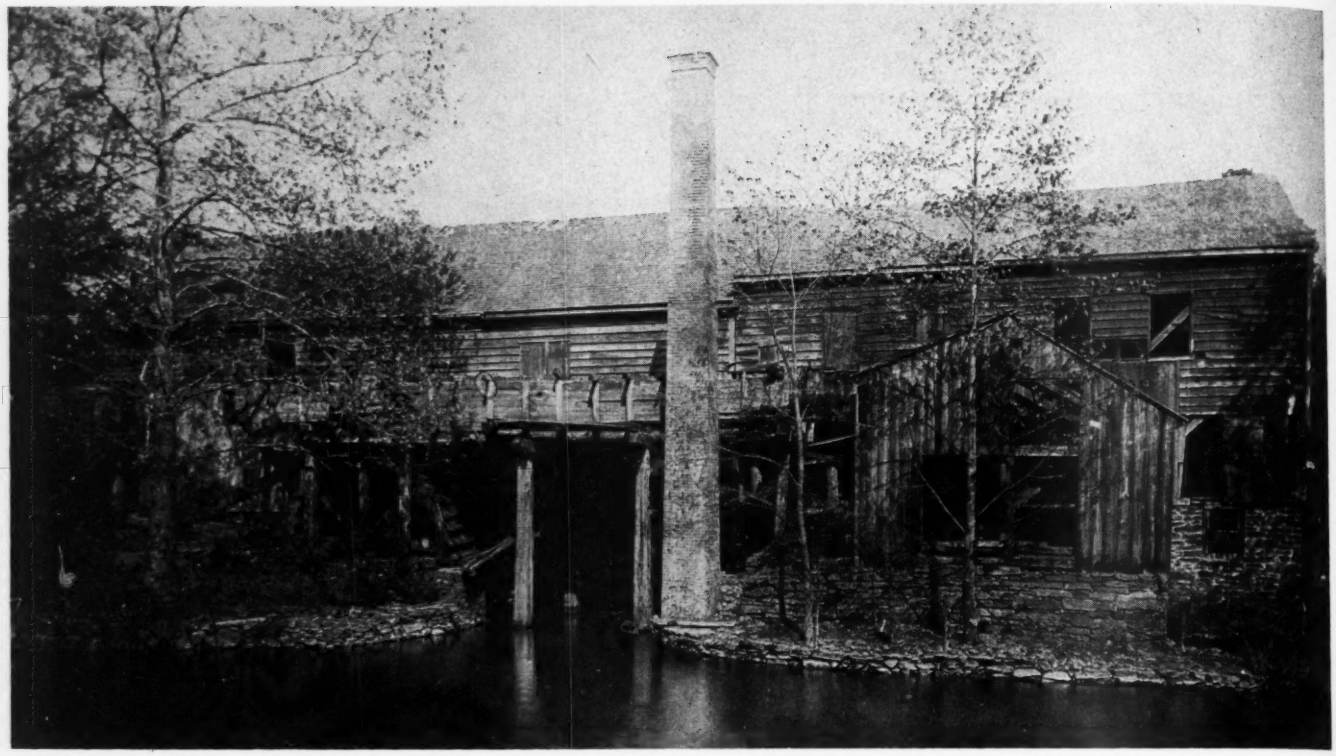
Trailing arbutus had become rather rare at the time steps were taken to protect it. This native of eastern North America, also called the Mayflower, is said to have been the first flower to greet the Pilgrims—but the fact remains that it has been sadly neglected for far too many years. In early

(Continued on page 224)

Below. Rootstock and panicle of false hellebore *(Veratrum viride)*.

Opposite page. False hellebore grows luxuriantly in this woods in Norwalk, Connecticut.





The old wooden mill, located on the Bronx River and bought in 1792 by Pierre and George Lorillard to be adapted to the manufacture of snuff.

THE LORILLARD SNUFF MILL — AN HISTORIC LANDMARK AT THE GARDEN

Based upon material prepared by Alice Sircom, Staff Associate (Public Relations) of The New York Botanical Garden.

VERY FITTINGLY, an historic landmark of an American industry that manufactures products from a plant stands on the grounds of The New York Botanical Garden, an institution that is dedicated to research and display of plants of the world. The industry, tobacco, uses a tropical American plant, *Nicotiana tabacum.*

In the 1760's, Pierre Lorillard, a young French Huguenot immigrant, had a tobacco "manufactory" on the High Road to Boston, later Chatham Street—now Park Row—in New York City, where he produced and sold products "of the best quality & flavor" from Virginia tobacco.

By the beginning of the eighteenth century, snuffing—and sneezing—had become an international vogue. Although snuff could be made by simply rubbing tobacco over a grater, Pierre Lorillard installed grinding stones which produced snuff of a better quality, and the Lorillard formulas were widely imitated. To keep it fresh, he originated the idea of packaging snuff in animal bladders that had been tanned and dried like parchment.

On May 27, 1789, his elder sons Pierre and George, who inherited the business, ran an advertisement. This showed an Indian holding a pipe and leaning on a hogshead marked "BEST VIRGINIA"; listed tobaccos and snuffs "sold reasonably, and warranted as good as any on the continent." This first known advertisement of America's oldest tobacco company promised "If not found to prove good, any part of it may be returned, if not damaged." The money-back guarantee thus made its appearance on the American business scene.

In 1792, Pierre and George moved their main factory north of the city to the Bronx River where they bought a grist mill, which they adapted to the manufacture of snuff, dam, water rights, buildings, and fifty acres. Later they acquired more acreage. Each mill worker was given a farm on the surrounding wooded property. The Lorillards harnessed the river to run their new mill, and even in the summer drought of 1798 it is reported that eleven and a half million gallons flowed by every twelve hours—nearly forty times the daily amount needed to supply the City of New York at the time.

About 1800 the Lorillards replaced the old wooden mill with a much larger one. The new mill, built of native fieldstone, was located a little farther up the river. Nearby was Pierre's famed "Acre of Roses," for he used roses to perfume the snuff. This mill operated until about 1870, when the family firm moved to a modern factory in Jersey City, New Jersey.

Other tobacco products, including chewing plugs, had replaced snuff by the time Pierre died in 1843. Mayor Philip Hone of New York City noted Pierre's death at the

age of eighty in his diary: "He led people by the nose for the best part of a century and made his enormous fortune by giving them to chew that which they could not swallow."

Around 1856, Pierre Lorillard III built a handsome forty-five-room fieldstone house, gate house, and stable near the mill. The mansion overlooked the Bronx River gorge and falls. The stable had Gothic windows with diamond-shaped panes of glass.

Some time after the firm moved to New Jersey, the family moved to Orange County, and there Pierre Lorillard VI built an elaborate mansion and developed Tuxedo Park.

In 1884, the City of New York acquired over six hundred and fifty acres of the Lorillard property in the Bronx. For a time the residence was used as the 41st Precinct Police Station. Later it was turned over to the Park Department, with the other buildings on the property, and was used as a meeting place and museum for the Bronx Society of Arts and Sciences. The mill was used for a carpentry shop, although the machinery and water wheels were left intact until about 1900.

When the Park Department gave the incorporators of The New York Botanical Garden two hundred and fifty acres of Bronx Park in 1896, the Department retained the Lorillard buildings. Then, in 1915, the Park Department granted The New York Botanical Garden an additional one hundred and forty acres which included the Lorillard buildings, in exchange for land cut off for new parkways.

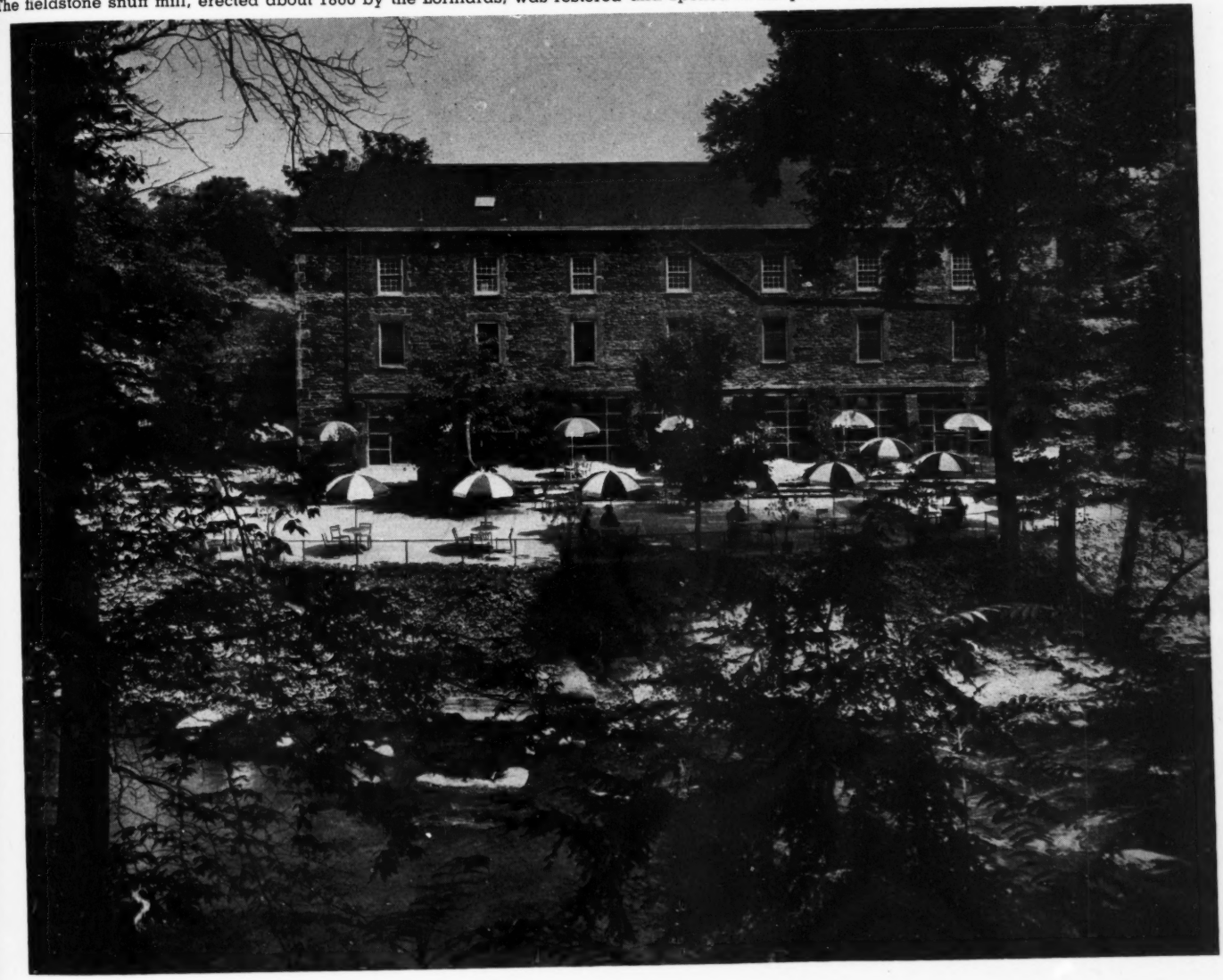
After renovation of the Lorillard mansion, the Bronx Society of Arts and Sciences continued to use part of it, and the Horticultural Society of New York was given space for offices. The New York Botanical Garden established carpentry, paint, and plumbing shops in the basement and workrooms on the second floor, and furnished a Members' Room. For a time the Garden ran a tea room there.

In mid-morning on March 26, 1923, a fire broke out on the roof of the mansion. Before the fire department arrived, the two upper floors were ablaze. The fire could not be brought under control for many hours, and the ruined mansion had to be razed. Some of the stone and brick were used to build boundary walls, paths, and catch-basins in the Garden.

The mill, known locally as the Old Snuff Mill, was used by the Garden for storage and a carpentry shop. In the

(Continued on page 223)

The fieldstone snuff mill, erected about 1800 by the Lorillards, was restored and opened to the public in 1954 as a restaurant and meeting place.



FLOWERS AND GARDENS IN MADEIRA

By MURRAY WRIGHT, N.D.H.

Mr. Wright, who resides in Allestree, Derby, England, is the holder of the National Diploma of Horticulture from the Royal Horticultural Society; this diploma is granted under an arrangement with the British government.

A view of Funchal Bay, Madeira.

PERHAPS FEW PLACES in the world rival the island of Madeira for floral and scenic beauty. Surrounded by the bluest of sunlighted seas and with a background of great purple mountains, this little island has a perfect setting for its abundance of colorful foliage and blooms.

Bougainvillea in brilliant tones of scarlet, purple, and lilac is suspended from sun-shadowed walls, rambles over trellises and pergolas, clings to trees and houses, and forms incredibly beautiful hedgerows by the wayside. In the spring the dazzling blue-flowered jacaranda trees adorn the streets of the capital city, Funchal; hydrangeas and agapanthus line the country roads; and in shady places the pure white arum-lilies and long-stemmed orchids seem to thrive without attention. In town and country flowers in endless variety bloom throughout the year. How appropriately Madeira has been named *Flor do Oceano* (Flower of the Ocean).

Madeira, an Atlantic island of volcanic origin, has been in the possession of Portugal since 1420. It is situated about three hundred and sixty miles from the coast of northwest Africa and is approximately thirty miles long and twelve miles wide. The center of the island consists of a range of mountains from which deep ravines and valleys extend towards the north and south coasts and in some places the sea. Consequently, while there are many scenes of picturesque grandeur, road-making is often difficult, and certain districts are rather inaccessible. Moreover, as most of the island consists of slopes of varying steepness, a great deal of terracing is necessary for crop cultivation. Commercially the island's farmers concentrate on bananas, sugar cane, and

A February scene in one of the gardens of the Quinta do Palheiro.

grapes; from the latter the famous Madeira wine is made.

The climate of Madeira is mild and equable; in the winter the mean temperature never falls below 55°F. Except in the high mountains, frost and snow are unknown. In the winter there is usually abundant rainfall; up to forty inches have been recorded between November and May. During the summer, however, long dry periods are not uncommon. Throughout the year there are few days without sunshine, and high winds are of rare occurrence. Such climatic conditions, together with a fertile soil, do indeed provide a gardener's paradise.

Botanists believe there is a connection between the original flora of Madeira and that of the West Indies and tropical America. This conclusion is based on the fact that six species of ferns, the lily-of-the-valley tree *(Clethra arborea),* and a tree laurel of the genus *Persea* are all common to the three places mentioned, while none of them is indigenous to Europe or North Africa.

Of course, a great number of plant species have been introduced to Madeira from different countries and diverse climates. So it is that the modest daffodil, primrose, and violet may be found in close proximity to the exotic and flamboyant poinsettia *(Euphorbia pulcherrima)* from Mexico. The flora of the Mediterranean region is particularly well represented.

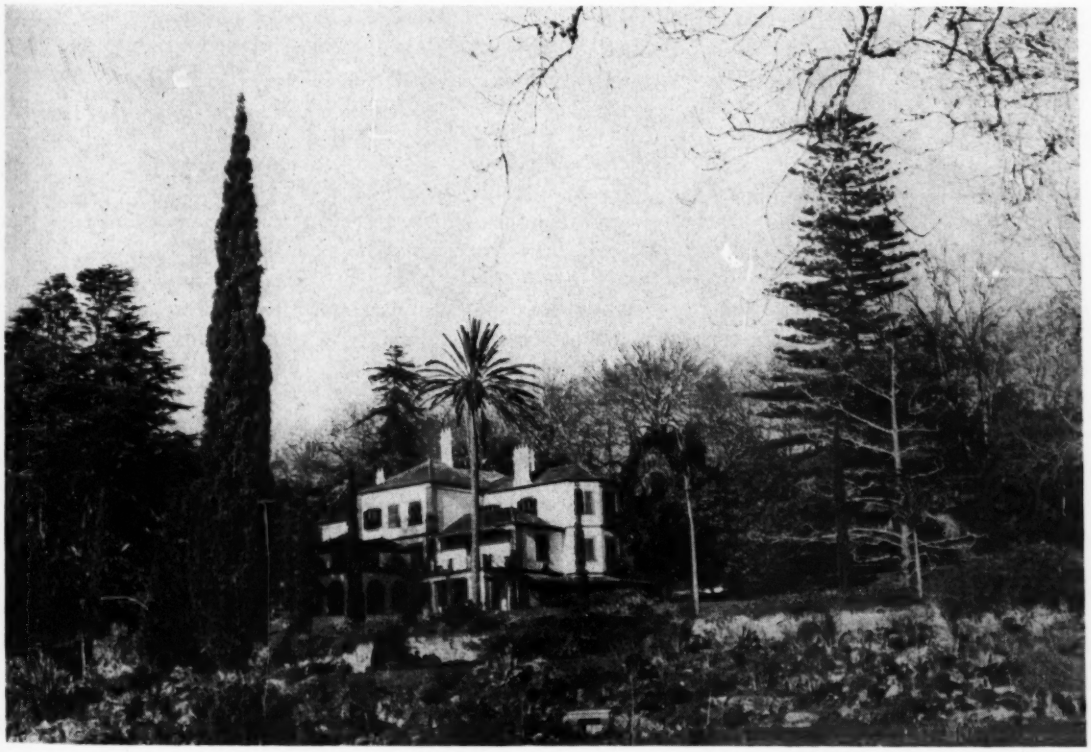
In this short article it is possible to mention only a few of the decorative plants to be seen in Madeira. In winter the glorious *Bougainvillea spectabilis* takes pride of place. There is also a summer-flowering species, *B. glabra,* which has lilac flowers. *Pyrostegia venusta* (syn. *Bignonia venusta)* is another spectacular winter-flowering vine. This native of South America produces dense clusters of finger-shaped, crimson-orange flowers.

Another outstanding climber of the *Bignoniaceae* frequently seen in Madeira is *Campsis radicans.* The variety *flava,* bright yellow in color, is particularly striking. But the loveliest of all is the bower plant of Australia *(Pandorea jasminoides);* it blooms in May and June. The scarlet passion flower *(Passiflora coccinea)* delights the eye in January and February. The wisterias, successfully grown in less favored climates, reach such a height of perfection in Madeira that they must be mentioned.

The maritime pine *(Pinus pinaster),* a native of the Mediterranean region, has been used extensively to clothe the island's hills and valleys with vegetation. But plants that bear bright flowers call for the greatest attention, and this applies to trees and shrubs. I have mentioned the jacaranda tree which is incredibly beautiful when in bloom. The species usually seen is *J. acutifolia* (syn. *J. mimosifolia).* In the lime-free soil of Madeira camellias thrive abundantly, as do magnolias. *Grevillea robusta* with golden-yellow flowers in summer, is frequently grown. Even more attractive are species of coral-trees, such as *Erythrina corallodendron* and *E. crista-galla,* each bearing large racemes of gorgeous blooms. The beautiful *Wigandia caracabana* (syn. *W. macrophylla)* produces loose flower heads of lilac-purple in winter, and I must not overlook the great white trumpets of *Datura* and the purple blossoms of *Tibouchina semidecandra* (syn. *Lasiandra macrantha).*

There are beautiful gardens in Madeira. An outstanding example is the Quinta do Palheiro, owned since 1885 by an English family named Blandy. The Palheiro garden, situated about five miles from Funchal on the eastern slopes of the Bay and about eighteen hundred feet above sea level, covers approximately thirty acres.

The grounds, which have been beautifully laid out, include two grand avenues of London plane trees *(Platanus acerifolia)* with one hundred trees on either side. It is esti-



Quinta do Palheiro is one of the most beautiful places on the island of Madeira. A rock garden may be seen in the foreground.

Flower girls in national costume sell flowers to tourists in Funchal.

mated that the garden contains ten thousand camellias in both single and double flowers, and in colors of white, pink, red, and purple, also striped and spotted varieties. Some of the camellias reach a height of well over thirty feet and flower continuously between December and May. There are camellia hedges which, in spite of severe pruning, flower profusely. Camellias have been used to line the main entrance to the Quinta. Forms of *C. japonica, C. sasanqua, C. reticulata,* and *C. saluenensis* are the ones mainly cultivated.

Great clumps of magnolias range in height from twenty-five to thirty feet. The species include *M. soulangeana, M. denudata, M. sieboldii, M. sinensis,* and *M. stellata.* The lovely bright yellow mimosas *(Acacia cyanophylla* and *A. decurrens dealbata)* also provide a wonderful picture in winter. Other notable trees at the Palheiro are redwood *(Sequoia sempervirens),* the maidenhair tree *(Ginkgo biloba),* the Norfolk Island pine *(Araucaria excelsa),* the tulip-tree *(Liriodendron tulipifera),* and the camphor tree *(Cinnamomum camphora).*

Several trees indigenous to Madeira are of particular interest to the visitors to this remarkable garden. These are the lily-of-the-valley tree, the dragon tree *(Dracaena draco),* the giant heath *(Erica arborea),* the Madeira holly *(Ilex perado),* and the jasmine-scented *Pittosporum coriaceum.* Large clumps of the brilliant bird of paradise flower *(Strelitzia regina)* and fine specimens of *Gardenia grandiflora* and *Paulownia imperialis* also command attention.

South African bulbous plants are well represented at the Palheiro; among them are nerines, babianas, ixias, sparaxis, and tritonias. Pure white arum-lilies are used most effectively to light up the shady parts of the garden, but it comes as a surprise to see cymbidiums and cypripediums also thriving in the shade. Cymbidiums grow here to a height of six feet.

There is every indication that the people of Madeira appreciate the climatic advantages of their island home. On the less precipitous hillsides thousands of little square houses have been erected, each attractively painted white and standing on its own plot. Each house is nearly always embellished with a vine or creeper-clad trellis, balustrade, or wall. The little gardens are well kept and all year long are bright with blooms.

Typical flowers for these better home gardens are begonias, pelargoniums which often grow into tall bushes, fuchsias, mauve lantanas, scarlet bouvardias, and bulbous plants. Freesias bloom in February and are followed by the brilliant orange tritonias; these in turn are succeeded by lovely blue babianas. In May red amaryllis grow side by side with pale pink *Crinum powellii.*

Perhaps the most popular plant of all for the small garden is the Japanese azalea *(Rhododendron indicum,* syn. *Azalea indica).* Sometimes this is planted in a border, more often it is grown in pots in the tiny courtyard whose pure white walls accentuate the brilliant color of the flowers.

In Funchal the flower girls offer the tourists bunches of arum-lilies, camellias, and long-stalked orchids at astonishingly cheap prices. In the country the children throw floral bouquets into passing cars in the hope of being rewarded with a few escudas. No wonder few leave Madeira without a bunch of the island's flowers.

SOIL pH: WHAT IT IS AND HOW IT AFFECTS SOIL FERTILITY

By ROBERT L. TICKNOR

Dr. Ticknor is Associate Professor of Horticulture at Oregon State University, Aurora, Oregon.

ONE OF THE misunderstood concepts in gardening is soil pH. Technically, pH is defined as a quantitive expression for acidity or alkalinity of a solution, that is, concentration of hydrogen or hydroxyl ions. The scale ranges from 0 to 14, with 7 being neutral, less than 7 being acid, and more than 7 being alkaline. Because pH is on a logarithmic scale, the concentration of hydrogen or hydroxyl ions increases or decreases ten times for each pH unit of change.

From the standpoint of the gardener, it is important that this symbolic number is an index of the suitability of a soil for the growth of plants. Some, such as azaleas, grow best in strongly acid soils near pH 5; others, such as sweet peas, near pH 7, the neutral point. Many plants will grow satisfactorily over a range of pH units, which for acid-tolerant plants could be from pH 4-6 and for many other plants from pH 6-8. Tables of pH preferences of plants appear in several books. One of the most extensive lists appears in *Our Garden Soils* by Charles E. Kellogg (1952).

The growth of plants is affected by soil pH in several ways. Probably the most important way is through the changes in the availability of various nutrient elements in the soil accompanying changes in the soil pH. These changes are illustrated in Figure 25, taken from *Commercial Flower Forcing* by Laurie, Kiplinger and Nelson (1958) and shown here with the permission of the authors and the publishers, McGraw-Hill Book Co., Inc. Calcium is tied up in insoluble forms at low pH, while aluminum and iron become soluble. At quite low soil pH, calcium deficiency and aluminum and iron toxicities can develop. To further complicate the situation, excessive amounts of aluminum and iron in turn can render phosphorus unavailable to plants by forming insoluble compounds with the phosphorus. An application of limestone, which contains calcium, will correct this situation by raising the pH, but the

higher pH may adversely affect some plants. This can be circumvented by an application of gypsum, which will raise the calcium and lower the manganese levels without altering the pH. High pH, brought about in some cases by overliming, reduces the availability of boron, iron, manganese, and phosphorus by causing the formation of insoluble compounds.

Figure 25 shows under average conditions the relationship between pH and the availability of the different nutrient elements. Such soil factors as the type of clay or the amount of organic matter in the soil can make a nutrient element available at a higher or lower pH level than this average. High organic matter reduces the ability of pH to affect the availability of nutrients. Fortunately, because of the limited size of most gardens, it is possible to add sufficient organic matter to the soil to offset unfavorable pH conditions.

Microorganisms react markedly to the pH of the soil. Fungi become the primary agents for the release of nitrogen from the organic matter in the soil in acid soils, while the bacteria that perform this vital task are most abundant in soils approaching neutrality. Below pH 6, the nitrifying bacteria which change ammonia to nitrates show little activity. Such acid-tolerant plants as blueberries and rhododendrons use the ammonia found in acid soils, while many plants can utilize only the nitrates found in soils approaching neutrality. Organisms that fix atmospheric nitrogen do not flourish below pH 5.7.

Earthworms, which require an abundance of calcium, are absent below pH 4.5. They do not live in strongly acid soils because of the low calcium supply. Moles, which feed on earthworms as well as on other soil fauna, are even more sensitive than their food supply to low pH levels, since they are not usually found below pH 5.5. One of the most striking effects of this lack of earthworm activity is the accumulation of a thatch of organic matter on the soil surface.

Two pH determinations of the same soil will not necessarily give the same reading. Readings can differ by as much as a pH unit, depending upon soil conditions. During the growing season the rate of oxidation of organic matter, the rate of uptake of plant nutrients, and the rate of leaching of plant nutrients from the soil will influence the pH of the soil. Soil moisture also influences the pH; a soil becomes more acid as it dries out. This may explain why some crops will tolerate greater acidity in soils that stay moist than in soils that dry out periodically. Even the amount of water used in making the determination can influence the reading.

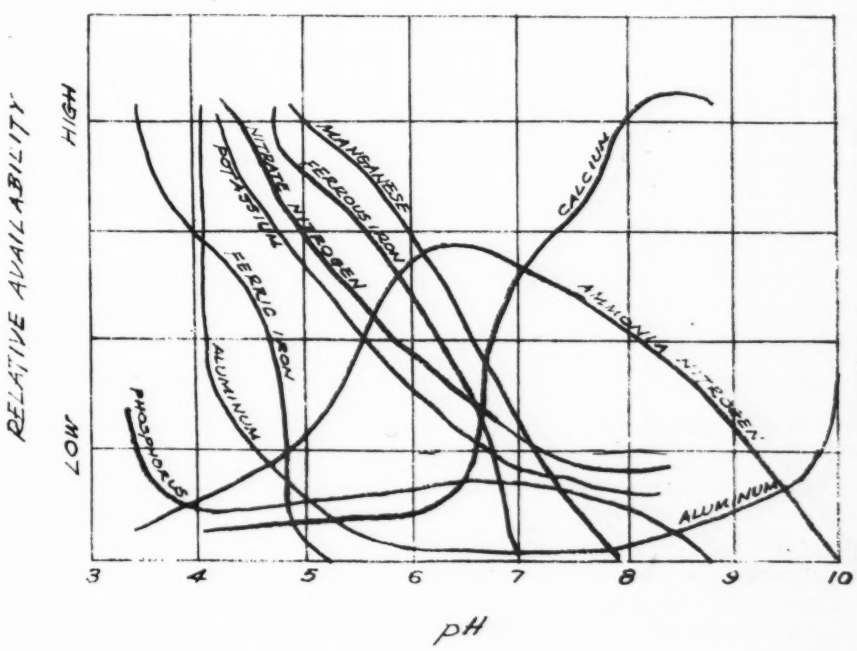


Figure 25 from *Commercial Flower Forcing*, McGraw-Hill Book Co. Inc., 1958.

Several soil conditions influenced by the pH of the soil have been outlined. Fortunately, it is not necessary for those of us who like to grow both acid-tolerant plants and plants that grow best in neutral soils to accept the native pH of our soils. The pH of an acid soil can be raised by the addition of limestone, while sulphur can be used to make an alkaline soil more acid. The amount of either material necessary to bring about the desired soil reaction can best be determined by having your state university's soil-testing laboratory or a commercial laboratory test your soil.

THE LORILLARD SNUFF MILL (Continued from page 219)

early 1950's, Mrs. Harold I. Pratt, a member of the Board of Managers of the Garden, aroused interest in restoring the mill for public use and donated $88,000 for the project. The P. Lorillard Company contributed $25,000, The New York Botanical Garden appropriated $20,000, and The City of New York appropriated the remaining $166,000 for the restoration of the mill as a meeting place and restaurant.

Located on sloping ground adjacent to the Bronx River, the building is two stories high on the upland side and three stories on the river side. The century-old beams were left exposed and show where the machinery for the grinding stones had been attached. These beams now go across the attractive Conference Room on the first floor. The ground floor, or river-side level, was converted into a modern snack bar and cafeteria, and a stone terrace built overlooking the river. The original structure was strengthened but changed little, except for floor-to-ceiling windows and doors in the restaurant and brick buttresses for support and decorative effect between the glass sections.

During the restoration workmen uncovered three millstones that were fifteen feet below the base of the west wall. One was of native New England granite, 47½ inches in diameter, 13 inches thick, with a 10 x 7-inch hole. The

other two seemed to be of volcanic rock and were encased in wrought iron, with two wrought-iron loops attached for the block and tackle. These were of the same diameter as the granite stone, 7 inches thick, with a 9½ x 12-inch hole.

Dr. Brian Mason, Curator of Geology at the American Museum of Natural History, was asked to analyze the volcanic composition. Dr. Mason reported that it was a porous basalt, consisting essentially of the minerals augite and feldspar—a type of rock that appears in many parts of the world, but not in the eastern United States and Canada. As it is not likely that the rock was hauled over the Rockies from California or elsewhere in that region in the mid-nineteenth century, Dr. Mason believes it probably came from southwestern Germany or southern Italy where similar rocks are prevalent. The Lorillards may have had the millstones made in a European quarry, brought by clipper ship to the downtown New York docks, and then hauled to the Bronx by bullock cart.

On April 10, 1954, the restored mill was officially named the Lorillard Snuff Mill and opened to the public. The Conference Room, with kitchen facilities, is used for functions of The New York Botanical Garden and may be rented by other groups and individuals.

The Snuff Mill Restaurant, which is open from the Saturday before Palm Sunday through the Saturday after Thanksgiving, is owned by the Garden, but operated by an outside concessionaire. Operated as a cafeteria, it is open daily between the hours of 10 a.m. to 6 p.m. The dining room is decorated with murals that depict the history of the P. Lorillard Company.

Visitors to the Garden will find tobacco, the tropical American herb that became "big business," growing in the economic plant house of the Conservatory of The New York Botanical Garden.

THE NATURAL SCIENCES (Continued from page 210)

When they returned from their walk, students and teachers although tired, hungry, and with blisters on their feet, had a clearer understanding why so many visit the Trailside Museum. Over a million and a half people have visited the Museum, now in its twentieth year; attendance has risen from less than thirty-five hundred in 1941 to two hundred and seventy-five thousand in 1960. A large share of the credit for this increase belongs to Dr. Moldenke, whose exhibits and talks on the wonders of nature fascinate youth and adult alike. Dr. Moldenke has been Director of the Trailside Museum nine years. He was formerly a member of the staff of The New York Botanical Garden for more than twenty years.

MODERN LILIES (Continued from page 197)

free from disease and thus offer clean material for propagation. Of course, this will not give the bulbs grown from such scales immunity to re-infection; but it would permit growers to produce clean stock, if the plants could be grown in isolation, and to learn just how much influence a virus has in reducing the flowering of many species and hybrids. While seed reproduction often shows that clean strains of a species are much more vigorous, the asexually propagated clones quite often become infected before the clone is disseminated. And, as with the very old hybrid Nankeen lily, *L. testaceum,* there is no way of knowing what a virus-free plant would be like. However, we are warned that this is not a "sure-fire" method of removing virus strains from lilies. Let us hope therefore that the search will go on for a treatment that will do so.

WILD FLOWERS (Continued from page 216)

spring the very fragrant, waxy white or flesh-colored flowers appear above its bright green leaves.

Another flower associated with childhood memories is the Mayapple *(Podophyllum peltatum),* also known as mandrake or Indian apple. It grows in rich woods. Its appearance is intriguing, because the palmately lobed leaves, ten inches or more across, give an umbrella-like effect. The cup-shaped flower is unpleasantly sweet, white and waxlike, and followed by a small yellowish apple. This is edible when fully ripe, but I have never eaten it; when it is not fully ripe, the fruit is considered dangerous. A drug is obtained from the rhizomes.

Virginia cowslip *(Mertensia virginica)* with its drooping funnel-shaped flowers, pink in the bud, opening to blue, and then fading to pink, is easy to grow in cool moist soil in partial shade. Its bluish green leaves disappear not long after the flowers have faded. This "die-back" habit is useful for it makes room for other plants. *M. virginica* seeds easily and may have to be controlled.

Many of the wild flowers that bloom in late summer are rather coarse, large plants and have no place in the small garden; they are better enjoyed where they grow in fields and woods and along country lanes. However, if your wild flower garden is sizeable, then Joe-Pye-weed *(Eupatorium purpureum),* boneset *(E. perfoliatum),* white snakeroot *(E. rugosum)* the goldenrods, ironweed *(Vernonia noveboracensis),* and the asters *(A. cordifolius, A. divaricatus, A. ericoides, A. linariifolius, A. novae-angliae, A. novi-belgii,* and *A. spectabilis)* may be grown. *A. linariifolius* is a very good plant for dry sandy soil; *A. spectabilis* for a moist open site; *A. cordifolius* and *A. divaricatus* for a partly shady spot. *A. novae-angliae* is one of the finest native species and from it, and also from *A. novi-belgii,* many beautiful horticultural forms have been developed.

We must face the fact that many of our wild flowers are being or have been destroyed by heedless picking, careless mowing and spraying, and by the bulldozer used in building roads and houses. If our wild flowers are to be saved, it is our responsibility to do all we can to protect them in nature and to grow them on our properties under the right conditions.

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BRIEF NOTES ON RECENT BOOKS

By ELIZABETH C. HALL

Miss Hall is Sarah Gildersleeve Fife Research Librarian of The New York Botanical Garden

GENERAL GARDENING

THE COMPLETE GUIDE TO GARDEN FLOWERS; AN ENCYCLOPEDIA OF GARDEN PLANNING. Askwith, Herbert, ed. 256 pages, 1,000 color plates. A. S. Barnes and Co., New York. 1961. $12.50.

Here is an answer to the layman's prayer for a one-volume gardening encyclopedia, generously illustrated in full color. Edited under the guidance of an advisory board of eminent horticulturists, this new arrival contains descriptive and cultural notes on more than two thousand plant and gardening subjects. A unique feature is the listing of the approximate retail price of many of the herbaceous plants and bulbs.

THE GARDENER'S REMINDER: A PICTORIAL ENGAGEMENT CALENDAR FOR 1962 WITH WEEK-TO-WEEK SUGGESTIONS. Jenkins, Dorothy. 112 pages, illustrated. Crown Publishers, New York. 1961. Spiral, $1.50.

To enumerate all the high spots of this calendar is just impossible. First of all, there are over fifty magnificent photographs of garden scenes and plants by the "perfectionists" Gottscho-Schleisner. Then, mention should be made of the quaint weather quotations gleaned from American folklore; of the many flower festival and show dates; and of the timely gardening advice (keyed to apply to the six major climatic zones of the United States). A most attractive, informative, and useful booklet.

HORTICULTURAL DICTIONARY IN EIGHT LANGUAGES. Nijdam, J., ed. 504 pages. Interscience Publishers, New York. 1961. $7.50.

This revised and expanded edition of *The Horticultural Word List in Seven Languages*, published by the Ministry of Agriculture and Fisheries in The Netherlands, Horticulture Division, is an "open sesame" for the research worker. Horticultural terms in Dutch, English, French, German, Danish, Swedish, Spanish, and Latin.

OUR GARDEN HERITAGE: ARTICLES FROM THE BULLETINS OF THE GARDEN CLUB OF AMERICA. Anderson, Alice Sloane, ed. 622 pages, 12 color plates, indexed. Dodd, Mead and Co., New York. 1961. $12.50.

A splendid selection of about two hundred papers on gardening and garden plants which have appeared in the *Bulletin of The Garden Club of America* from 1913 to 1958. Among the authors are such widely known horticulturists as Mrs. Francis King, Mrs. Marian C. Coffin, Mrs. Mortimer J. Fox, Mrs. Anna Gilman Hill, Dr. B. Y. Morrison, Dr. Clement G. Bowers, Dr. John C. Wister, Mrs. Louise Beebe Wilder, and Miss Gertrude Jekyll. The reproductions in color are from the works of Redouté, Edwards, Catesby, and Thornton.

PLANT PRUNING IN PICTURES; HOW, WHEN, AND WHERE TO PRUNE, AND WITH WHAT TOOLS. Free, Montague. 286 pages, illustrated, indexed. Doubleday and Co., Garden City, N. Y. 1961. $4.95.

Montague Free, with his rich background of gardening practice and of teaching and writing experience, offers a "visual instruction" volume on the difficult and controversial subject of pruning.

GARDEN PLANTS

CAMPANULAS AND BELLFLOWERS IN CULTIVATION. Crook, H. Clifford. 90 pages, illustrated, indexed. St. Martin's Press, New York. 1961. $2.50.

A popular treatment by the foremost writer on campanulas. Recommended to those gardeners who appreciate the differences between English and American climatic conditions and cultural practices.

THE COMPLETE BOOK OF LILIES. Rockwell, F. F., Esther C. Grayson, and Jan deGraaff. 352 pages, illustrated (part colored), bibliography, indexed. Doubleday and Co., Garden City, N. Y. 1961. $5.95.

The trio who have authored this latest work on lilies is a combination par excellence—Jan deGraaff, President of the Oregon Bulb Farms, with a rich background of experience as a commercial grower and hybridizer; Esther Grayson and Fred Rockwell, distinguished "dirt gardeners," who have previously written many excellent gardening books and have grown successfully countless lilies in their garden in New York and later on Cape Cod. In the present volume, just about everything that pertains to a lily has been discussed and illustrated in detail—the botany, history, culture (greenhouse and out-of-doors), propagation, breeding, exhibiting, judging, flower arrangement, native and foreign species, hybrids, and registration. The appendix has countless lists of lilies for various purposes, such as shade, color, height, and last, but by no means least in usefulness, is the list of over two hundred and fifty plants called "lilies" that are not true lilies.

DAHLIAS. Ogg, Stuart. 123 pages, illustrated, indexed. Penguin Books, Baltimore, Md. 1961. Paper, $1.25.

A Penguin handbook prepared in conjunction and collaboration with the Royal Horticultural Society, and written by a well-known English nurseryman who is Chairman of the National Dahlia Society.

HARDY HEATHS AND SOME OF THEIR NEARER ALLIES. Johnson, A. R. 127 pages, colored front, illustrated, indexed. St. Martin's Press, New York. $2.50.

Another authoritative British text on a fascinating group of plants, not all of which love our American environment. This is a revised edition of an old favorite among English gardeners. The last chapter on the subject of heaths in industry and legend is delightful reading.

THE NEW PERENNIALS PREFERRED. Wilson, Helen Van Pelt. 320 pages, illustrated, indexed. M. Barrows and Co., New York. 1961. $4.95.

Helen Van Pelt Wilson loves perennials, and she writes about them with a contagious enthusiasm. Sixteen years have gone by since her *Perennials Preferred* first appeared. The present volume, written from her Westport, Connecticut, home contains many new ideas and observations as well as numerous planting diagrams, charts, tabulations, and photographs. Of current value is her list of nursery specialists who issue catalogs.

SUCCULENTS IN CULTIVATION (CACTI INCLUDED). Higgins, Vera. 168 pages, illustrated (part colored), indexed. St. Martin's Press, New York. 1961. $4.95.

One of England's experts on succulent plants is the author of this well-illustrated little book. Mrs. Higgins and her husband own an extensive collection of these plants, and they have been growing and observing them for over thirty years. There are good descriptions and specific cultural directions.

VARIEGATED FOLIAGE PLANTS. Fischer, Paul. Transl. and ed. by Corry Van Alphen. 136 pages, illustrated (part colored) St. Martin's Press, New York. 1961. $3.50.

The first book in recent years devoted exclusively to the culture of house and greenhouse plants with variegated foliage. Over one hundred genera are included, and authorities are given for the binomials as well as for most of the varietal names.

HERBS AND FRUITS

CULINARY AND MEDICINAL HERBS, 3rd ed. Ministry of Agriculture Bulletin No. 76. 41 pages. 1960. British Information Services. New York. Paper, 60 cents.

This informative bulletin from overseas deals with the cultivation of about three dozen herbs which are grown for culinary, medicinal, confectionery, and perfumery purposes. The more important commercial crops are given special attention, but the herbs of interest to the home owner are also included.

FRUITS IN THE HOME GARDEN: A HANDBOOK. Slate, George M., guest editor. 96 pages, illustrated. Brooklyn Botanic Garden, Brooklyn, N. Y. 1961. Paper, $1.00.

A concise booklet on the raising of small, bush, and tree fruits and also nuts. Certain sections are devoted to recommendations for specific climatic conditions that are found in our western, prairie, and southern states. Problems of pruning, fertilizing, and pests are expertly handled.

A HERB A WEEK: 1962. Whitman, Helen M., comp. 52 pages. Colored cover. The Tool Shed Herb Nursery, Salem Center, N. Y. 1961. Paper, $1.25.

Delightfully different each year is this herb engagement calendar, with a daily herb-lore quotation from some quaint old text or a timely bid of sound herb-gardening advice.

BOOKS FOR CHRISTMAS

Books are a happy choice for Christmas gifts—a reminder of your thoughtfulness the year round.

Books reviewed in the pages of *The Garden* Journal, or any book on botany, gardening, flower arrangement, natural science, or kindred subjects may be ordered through Book Service.

Members are entitled to a ten per cent discount on the list price. Please send check or money order payable to The New York Botanical Garden with your order.

FLOWER ARRANGEMENTS AND FLOWER SHOWS

THE FLOWER ARRANGEMENT CALENDAR: 1962. Wilson, Helen Van Pelt. 110 pages, colored cover, illustrated. M. Barrows and Co., New York. 1961. Spiral, $1.50.

This is the sixteenth annual issue of Mrs. Wilson's popular engagement calendar, well up to the standards set in former years. The flower arrangement photographs come from England, Canada, Australia, Japan, Chile, and from twenty-two of our own states.

GROWING FOR SHOWING. Favretti, Rudy J. 142 pages, colored front, illustrated, indexed. Doubleday and Co., Garden City, N. Y. 1961. $3.95.

Instructions for the would-be exhibitor of prize-winning flowers, fruits, and vegetables by an experienced garden specialist on the staff of the Co-operative Extension Service of the University of Connecticut.

HOURS AND FLOWERS; THE ACCORDION ENGAGEMENT CALENDAR OF JAPANESE FLOWER ARRANGEMENTS. Carr, Rachel E. 102 pages, illustrated (part colored). Charles E. Tuttle Co., Rutland, Vt. 1961. $3.95.

Very Japanese in format and in the covers which are made of Japanese silk. It opens and shuts in an accordion-like manner. About fifty photographs of Japanese arrangements are accompanied with analytical captions. Quite charming.

A TEACHER'S GUIDE TO FLOWER ARRANGEMENT. Fox, Raymond T. 40 pages, illustrated. Kenneth Post Foundation, Ithaca, N. Y. 1960. Paper, gratis.

Six lesson-plans for teaching the principles of elementary flower arrangement are made available by the Kenneth Post Foundation as a contribution to youth education in floriculture.

BIOGRAPHY, HISTORY, AND TRAVEL

COLONIAL WILLIAMSBURG: ITS BUILDINGS AND GARDENS: A DESCRIPTIVE TOUR OF THE RESTORED CAPITAL OF THE BRITISH COLONY OF VIRGINIA, rev. ed. Kocher, A. Lawrence and Howard Dearstyne. 104 pages, illustrated, bibliography, indexed. Holt, Rinehart and Winston, New York. 1961. $3.95.

Written by two widely known architects who were formerly associated with Colonial Williamsburg. The fine photographs represent the collective work of talented experts.

DISCOVERY: GREAT MOMENTS IN THE LIVES OF OUTSTANDING NATURALISTS. Terres, John K., ed. 338 pages, J. B. Lippincott Co., Philadelphia. 1961. $6.50.

John Terres, formerly editor of *Audubon Magazine*, has brought forth a collection of the most extraordinary accounts of adventures and experiences by contemporary naturalists, here and abroad. Thirty-six internationally famous wild-life travelers and explorers (one of whom is a woman) have each (in response to Mr. Terres' request) written of a memorable experience that is linked with the discovery of something new to natural hitsory.

THE DRAGON TREE: A LIFE OF ALEXANDER, BARON VON HUMBOLDT. Gendron, Val. 214 pages, illustrated, bibliography, indexed. Longmans, Green and Co., New York. 1961. $3.95.

A fine, inspiring, and exciting biography of a dynamic scientist, explorer, and statesman.

THE EXPLORATION OF THE COLORADO RIVER. Powell, John Wesley. 176 pages, illustrated, indexed. (The Natural History Library) Doubleday and Co., Garden City, N. Y. Paper, 95 cents.

One of the great figures in the opening of the American West was Major Powell, who in 1887 succeeded Clarence King as director of the U. S. Geological Survey and was also director of the Bureau of Ethnology from its inception until his death in 1902.

FOREST VENTURE: CONQUERING THE DESERTS OF THE MIDDLE EAST. Maitland, Louise G. 192 pages, illustrated, indexed. International Publications Service, New York. 1960. $4.50.

Observations of the wife of a British forester, who accompanied her husband on a tour of the Middle East and northern Africa—Lebanon, Cyprus, Syria, Iran, Algiers, Morocco, and Egypt.

JOHN AND WILLIAM BARTRAM'S AMERICA: SELECTIONS FROM THE WRITINGS OF THE EARLY AMERICAN NATURALISTS. Cruickshank, Helen G., ed. 378 pages, illustrated, indexed. (The Natural History Library) Doubleday and Co., Garden City, N. Y. 1961. Paper, $1.45.

Helen Cruickshank's editing and biographical introduction are well done. Particularly useful is the inclusion of valid scientific names of plants and animals with the Bartrams' eighteenth-century nomenclature.

JOHN BURROUGHS' AMERICA: SELECTIONS FROM THE WRITINGS OF THE HUDSON RIVER NATURALIST. Wiley, Farida E., ed. 293 pages, illustrated, bibliography, indexed. (The Natural History Library) Doubleday and Co., Garden City, N. Y. Paper $1.45.

To have known John Burroughs and his beloved "Slabsides" was Farida Wiley's good fortune. Her introduction and editing show a wonderful understanding of a unique figure. Delightful reading for nature lovers.

JOURNAL OF A RESIDENCE ON A GEORGIAN PLANTATION IN 1838-1839. Kemble, Frances Anne: edited and introduction by John A. Scott. 415 pages, illustrated, bibliography, indexed. Alfred A. Knopf, New York. 1961. $5.75.

Thanks to the perseverance of an ardent lover of historical source material, John A. Scott, Head of the History Department of the Fieldston School in Riverdale, New York, there has been republished an almost forgotten, famous pre-Civil War diary of a leading English actress who married a wealthy cotton and rice planter. Mr. Scott's documented introduction is a scholarly contribution.

JUST ABOUT EVERYTHING IN THE ADIRONDACKS. White, William Chapman. 101 pages, illustrated. The Adirondack Museum, Blue Mountain Lake, N. Y. 1960. Paper, $3.50.

A choice selection of the nature writings of the late William Chapman White. Much of this material appeared in the columns of *The New York Times* and *The New York Herald Tribune*.

THE MOUNTAINS OF CALIFORNIA. Muir, John. 300 pages, illustrated, indexed. (The Natural History Library) Doubleday and Co., Garden City, N. Y. 1961. Paper, $1.25.

A paperback reissue of John Muir's first book that appeared in 1894 and played an important role in the battle for conservation.

NATURE'S YEAR: THE SEASONS OF CAPE COD. Hay, John. 199 pages, illustrated. Doubleday and Co., Garden City, N. Y. $4.50.

Poetic prose by the talented president of the Cape Cod Junior Museum. Illustrated with delightful woodcuts by David Grose.

PILGRIMAGE FOR PLANTS. Kingdon-Ward, Frank. 191 pages, illustrated, bibliography, indexed. George G. Harrap and Co., London. 1960. $2.75.

Observations on plants and plant collecting by the late Kingdon-Ward, one of England's great plant explorers. William T. Stearn of the Department of Botany of the British Museum (Natural History) has written a splendid biographical introduction and has compiled the lengthy list of Kingdon-Ward's publications.

THE OCEAN ISLAND (INAGUA). Klingel, Gilbert C. 415 pages, illustrated. (The Natural History Library) Doubleday and Co., Garden City, N. Y. 1961. Paper, $1.45.

A reissue of the popular account of two wild-life expeditions to the lonely island of Inagua in the Bahamas. Mr. Klingel is the author of *The Bay*, which won for him the John Burroughs Medal for excellence in nature writing. writing.

THE PACIFIC ISLANDS, rev. ed. Oliver, Douglas L. 456 pages, illustrated, bibliography, indexed. (The Natural History Library) Doubleday and Co., Garden City, N. Y. Paper, $1.45.

The Curator of Oceanic Ethnology at Harvard University paints a vivid picture of the life and customs of the peoples of Micronesia, Melanesia, and Polynesia. Of particular interest are the parts dealing with such economic plant products as sugar, coffee, coconut, sandalwood, and pineapple.

REDWOOD POEMS; MOODS AND SCENES FROM THE LAND OF GREEN GIANTS. Coblentz, Stanton A. 80 pages. Naturegraph Co., Healdsburg, Cal. 1961. Paper, $1.50; cloth, $2.50.

A selection from previously published books of Stanton Coblentz. Not only does the poet sing of the sequoias, but also of the plants and animals which form the ecological background of the redwoods.

SHEARWATERS. Lockley, R. M. 256 pages, indexed. (The Natural History Library) Doubleday and Co., Garden City, N. Y. 1961. Paper, $1.25.

This book about birds has running through it valuable observations on the plants and terrain with which the birds are associated. The shearwaters breed on islands off the Welsh coast and migrate to sunny lands near the shores of Portugal.

WHITE WATERS AND BLACK. MacCreagh, Gordon. 335 pages, illustrated. (The Natural History Library) Doubleday and Co., Garden City, N. Y. 1961. Paper, $1.45.

One of the most readable and amusing accounts ever written on exploration in the wild jungles of South America. Long out-of-print, its appearance in a paperback should charm old and new readers alike. Dr. James A. Oliver, Director of The American Museum of Natural History, suggests in the Forword that this be "required reading" for armchair travelers as well as for "sweat and toil" trippers.

WILDERNESS: THE DISCOVERY OF A CONTINENT OF WONDER. Platt, Rutherford. 310 pages, illustrated, indexed. Dodd, Mead and Co., New York. 1961. $6.00.

A dramatic, informative story of three hundred years of exploration in America from coast to coast, by one of the popular nature writers and photographers. Mr. Platt has been a member of The New York Botanical Garden for many years.

FOR YOUNGER READERS

LOUIS AGASSIZ: ADVENTUROUS SCIENTIST. Tharp, Louise Hall. 200 pages, illustrated, indexed. Little, Brown and Co., Boston. 1961. $3.75.

Mrs. Tharp gained great fame with one of her adult books, *The Peabody Sisters*. She has made a study of New England's notables and now presents a lively biography of Agassiz for teen-agers.

MORE RESEARCH IDEAS FOR YOUNG SCIENTISTS. Barr, George. 158 pages, illustrated, bibliography, indexed. Whittlesey House, McGraw-Hill Book Co., New York. 1961. $3.00.

Another welcome title from the author of *Young Scientist Takes a Walk*, *Young Scientist Takes a Ride*, and *Research Ideas for Young Scientists*. "Are Only the North Sides of Trees Green?"; "How Do Dandelions Ruin Lawns?" —all sorts of fascinating problems to solve.

MUIR OF THE MOUNTAINS. Douglas, William O. 183 pages, illustrated, indexed. Houghton Mifflin Co., Boston. 1961. Paper, $1.95; cloth, $2.80.

A Supreme Court Judge, who is also one of our country's great conservation disciples, has written a fine biography of the "Father of our National Parks," for teen-agers.

MY HOME IN THE ZOO. Iles, Gerald. 239 pages, illustrated. Doubleday and Co., Garden City, N. Y. 1961. $4.50.

There is never a dull moment in life at the zoo, according to Gerald Miles who has spent his adult years in close contact with "wild" animals in captivity. Fairfield Osborn, President of the New York Zoological Society, has written a glowing introduction.

1001 QUESTIONS ANSWERED ABOUT THE SEASHORE. Berrill, N. J. and Jacquelyn Berrill. 305 pages, illustrated, bibliography, indexed. Grosset and Dunlap, New York, 1961. Paper, $1.75.

Which of the following belong to the plant world: sea anemones, sea grapes, mermaid's cup, periwinkle, sea cucumbers, sea lettuce, sea pansy, sea peach? Be careful, it's a catch question, but the answer is in this fascinating quiz book.

SCIENCE BOOK-LAB OF SEEDS. Selsam, Millicent E. 46 pages, illustrated. (Basic Books Science Book-Lab Series). Science Materials Center, New York. $3.95.

"Do-It-Yourself" kits combine fun and learning. This kit consists of a well-illustrated book of instructions and explanations, a planter with lid and water-tray, vermiculite, fertilizer-tablets, magnifying glass, labels, two plastic vials, and seeds of radish, mung beans, peas, peanuts, and lima beans. Millicent Selsam is recognized as one of the leading teacher-trained science writers for young people.

THE FIRST BOOK OF WILD FLOWERS. Cavanna, Betty. 68 pages, illustrated, bibliography, indexed. Franklin Watts, New York. 1961. $1.95.

Another of "The First Book Series" with especially fine text, format, and illustrations. There are intriguing headings such as "Plants That Set Traps," "Wild Flower Plants That Are Good To Eat," "Amusing Wild Flower Nicknames," and "How to Start a Wild Flower Garden."

THE HOW AND WHY WONDER BOOK OF THE MICROSCOPE AND WHAT YOU SEE. Keen, Martin. 48 pages, illustrated (part colored). Grosset and Dunlap, New York. 1961. $1.00.

A thrilling introduction to the workings of a simple and compound microscope with very fine illustrations. Clear instructions are given for the staining of slides, drop mounts, the growing of molds, and so forth.

TRAILS OF HIS OWN: THE STORY OF JOHN MUIR AND HIS FIGHT TO SAVE OUR NATIONAL PARKS. Grossman, Adrienne and Valerie Beardwood. 206 pages, illustrated, bibliography. Longmans, Green and Co., New York. 1961. $3.95.

A fictionalized biography that will hold the interest of a young reader and will instill a love for the great California country of John Muir.

DELIGHTFUL HOLLOW-LOG FEEDER

will give you endless pleasure as you watch the birds flock to it. A genuine hollowed-out log with copper ridge and hanging ring, filled with a high-energy seed and suet mixture loved by chickadees, woodpeckers, etc.

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25 DeRussey Lane, Cornwall, N.Y.

WONDERS OF OUR NATIONAL PARKS. Thomson, Peter. 63 pages, illustrated, indexed. Dodd, Mead and Co., New York. 1961. $3.00.

Here is the twenty-fourth title in the excellent "Wonder Book Series" for pre-teen readers. The author grew up in Yosemite National Park, where his father was superintendent.

WONDERS OF THE WORLD BETWEEN THE TIDES. Wakeman, Norman H. 63 pages, illustrated, indexed. Dodd, Mead and Co., New York. 1961. $2.95.

The photographer of some of the thrilling Disney Nature Films has written and illustrated this attractive text for young naturalists. He and his family are ardent seashore enthusiasts.

SOUTHERN CALIFORNIA GARDENS. Padilla, Victoria. 359 pages, illustrated, indexed. University of California Press, Berkeley, 4, California. 1961. $10.00.

This is a book every garden-minded visitor and resident in southern California should own. It is an encyclopedia of gardens, gardeners, and plants of the region. The book shows Miss Padilla to have had experience in writing. She is a member of the English faculty of Los Angeles College and has a literary style pleasant to read.

She tells how many different plants were grown in California before 1800. Much was brought from Spain, but many plants came from South America and the Pacific Islands.

(Continued on page 232)

NEWS, NOTES and COMMENTS

A Systematic Border is being established at The New York Botanical Garden to show examples of plant families as well as the arrangement in order of the families by botanists. It follows the general order of Engler and Prantl, which is widely used throughout the world by botanists.

The border, approximately six hundred feet long, is divided into thirty-nine beds and at the present time contains over four hundred plants illustrating seventy-seven families. The beds, which start with the grass family, *Graminae*, and proceed to the composite family, *Compositae*, demonstrate the evolution of plants from those that have an extremely simple flower to those that have a flower of highly complicated structure.

The plantings will be augmented as plants become available. In the main, annuals and perennials will be used, but it may be necessary to plant out some tropical species during summer to represent a particular family.

The systematic border is being developed to acquaint the public with the different plant families and to show them representative members of these families. Some visitors were amazed this past summer to learn that the weed *Galinsoga ciliata*, which they pull out of their flower borders, is a relative of the chrysanthemum, which they strive to cultivate to perfection. Both are *Compositae*. Other visitors were no less surprised to learn that the star-of-Bethlehem *(Ornithologalum umbellatum)*, which spreads so much that it is regarded as a "nuisance" plant, is a relative of the lovely Solomon's seal *(Polygonatum commutatum)*, which is frequently grown in the native plant garden, and of the beautiful yellow day-lily *(Hemerocallis flava)*. These last three plants are members of the lily family, *Liliaceae*.

T. H. Everett, Assistant Director (Horticulture) and Senior Curator of Education, and Louis P. Politi, Horticulturist, are responsible for the systematic border. It should prove to be an educational asset of The New York Botanical Garden not only in its service to the public, but also to the more serious student of plants.

Children's Gardencraft Class. Graduation exercises were held in the Recreational Hall of Bedford Park Presbyterian Church, New York City, on August 26, 1961, at which certificates and prizes were presented. Lillian Weber, the Garden's instructor, spoke of the work and showed slides of the children's gardens. Howard W. Swift, Assistant Curator of Education, informed the large audience of parents and friends of the fund for book prizes that has been created by Mrs. Herman M. Kurtz in memory of her brother, Dr. Jacob Schnur. Dr. Schnur, a physician who practiced in the Bronx, enjoyed walking daily through The New York Botanical Garden. Mrs. Hiram McCann, a past director of the Ninth District of the Federated Garden Clubs of New York State, Inc., presented books to the following: Beginners—girls, first, Laura Fennell, second, Linda Kwartler, third, Irma Haas and Linda Watanabe; Beginners—boys, first, Michael Weinstein, second, Michael O'Leary, third, Daniel Dunning; Advanced—first, Paula Matheson, second, Patricia Mullaney, third, Leonard Feigenbaum; Monitors—Lenore Wile and Kenneth Foley.

Elizabeth C. Hall, Sarah Gildersleve Fife Research Librarian, talked to the children on "Taming Wild Vegetables—From the Caveman Down Through the Centuries." She told them that all our tame or cultivated vegetables have come from wild or native plants, which once grew in the fields before man became civilized. Our carrots first came from Afghanistan; later the Romans and Greeks grew carrots and fed them to their horses to make their coats glossy. The Pilgrims brought lettuce seed to America when they came on the "Mayflower." Lettuce still grows wild along the shores of the Mediterranean. Spinach came from Persia; but it, too, found its way to America. Today, down in Texas, spinach is grown and shipped in carload lots all over the United States. Crystal City, Texas, is called the spinach capital of the world; right in the middle of the city is a large statue of "Popeye the Sailor," who taught boys and girls to eat spinach every day so that they would be strong and healthy. From Africa came the watermelon, and many a traveller has been saved from dying of thirst by the juicy watermelon which grows wild in arid regions of Africa. Leeks were first found in western Asia, but they finally reached England and Wales. In a battle between the Welshmen and the Saxons, so the story goes, St. David told the Welsh captain to order each Welshman to put a leek in his hat so that he could recognize his own countryman. The Welsh won the battle and ever since that time the national plant of Wales has been the beloved leek.

"What did Columbus find when he landed in 1492 in America?" Miss Hall queried, and answered, "Vegetables that were very strange to him—potatoes, tomatoes, peppers, pumpkins, squash, lima beans, peanuts, and corn—all grown by the Indians. When Columbus went back to Europe, he took seeds from these American vegetables with him. Soon his countrymen learned to eat them and found them very good.

"Today, we are living in a wonderful world. Scientists are discovering how to breed bigger and better fruits and vegetables. We enjoy seedless watermelons, seedless grapes, seedless grapefruits and oranges, stringless beans, and jumbo peanuts. It's fun to read the stories about our vegetables and fruits. If you are curious to learn

Representative members of the *Compositae* in the systematic border of The New York Botanical Garden.

more about the plants that you grow and eat, visit the Library of The New York Botanical Garden. A corner in the Library is reserved for boys and girls, and there you will find books with pictures and exciting stories of wild and tame plants."

The Dahlia Display at The New York Botanical Garden again served as the Eastern Trial Grounds for The American Dahlia Society with fifty-one new entries and eleven re-entries from last year. Judges of the Society visited the planting on several occasions to rate the dahlias. They commented favorably on the excellent care they were receiving under the direction of Louis P. Politi, Horticulturist.

In addition to these dahlias, approximately ninety other varieties were grown; these ranged from tiny pompons to large formal decoratives measuring twelve to fourteen inches across.

The display was scheduled to be at its peak the weekend of September 23, 1961; unfortunately, hurricane "Esther" the night of September 20 played havoc with this large crescent-shaped border. The plants staged a recovery and were fine in late October.

Gifts to the Garden. The Malba Garden Club, in appreciation of the information and assistance made available to it through the courtesy of Miss Hall, Dr. Rickett, Mr. Politi, and other members of the Garden's staff have contributed $25.00 to the Library Fund. The Morristown Garden Club also contributed $25.00 to this fund.

Mr. and Mrs. John E. Lockwood contributed $5,000.00 to the Native-Plant Garden, and the Advisory Council a like amount.

$11,200 have been received for the Garden's Endowment Fund from the estate of Mary Thurston Cockcroft.

Activities of the Director and Staff. Within the past few months, Dr. William C. Steere, Director, attended a luncheon and meeting, in New York City, of the Cultural Institutions Group; gave a lecture before the Garden Club of Mt. Vernon, New York; attended a meeting in Albany, New York, of the Council of the New York State Association of Museums, a meeting in New York City of State Education Commissioner Allen's Committee on Museum Resources, a meeting in Washington, D. C., of the evaluating committee of life sciences of the National Academy of Sciences—National Research Council to evaluate National Science Foundation postdoctoral fellowships; addressed the first meeting in the fall of the Volunteer Associates of The New York Botanical Garden; attended the dedication ceremonies, in Pittsburgh, of the Rachael McMasters Miller Hunt Botanical Library, the annual meeting, in Philadelphia, of the Board of Trustees of *Biological Abstracts*, a meeting in Washington, D. C., of the executive committee of the A.I.B.S. Biological Sciences Communications Project, and the annual meeting of the New York State Association of Museums at Cooperstown, New York; and addressed the sixteenth annual American Horticultural Congress at Northampton, Massachusetts, on the subject of "Science Lends a Hand to the Busy Gardener."

T. H. Everett, Assistant Director (Horticulture) and Senior Curator of Education, addressed the Advisory Council at its meeting on October 26, 1961, held at the Snuff Mill.

Howard Swift, Assistant Curator of Education, visited Michigan State University and the Beal Botanic Garden at East Lansing, Michigan. The latter, which is fairly extensive, has a good arrangement of plants by families in a natural planting.

Louis P. Politi, Horticulturist, judged the flower shows of the Pegasus Garden Club of Socony Mobile Oil and the Maiden Lane Garden Club of the Home Life Insurance Co.

Dr. David J. Rogers, Curator of Economic Botany, enjoyed a "busman's holiday" during his vacation. He visited several places near Asheville, North Carolina, where fine furniture is made, to learn more about the present sources of supply for hardwood and what is being done about hardwood reforestation.

Dr. Marjorie Anchel, Senior Research Associate, and Dr. George Bistis, who formerly worked in our Research Laboratory and returned in September, as Research Associate, to collaborate with Dr. Anchel, have received grants from the National Institutes of Health. Dr. Anchel's grant is entitled "Unusual Fungal Products; their chemistry and relation to biological problems." Dr. Bistis has received two grants: the one to enable him to collaborate with Dr. Anchel, entitled "Genetics of Biochemical Variations in Basidiomycetes"; the other for his own research, entitled "Compatibility Locus in *Ascobolus stercocarius*." Dr. Bistis is replacing Dr. Nalini N. Valanju, Research Associate, who left to join the staff of the Institute of Muscular Diseases, affiliated with Rockefeller Institute, in New York City.

Vincent Ravachieri of Iona College has replaced Bernard Russ who left the Research Laboratory, where he had been employed since January, 1956, to work with Ciba Pharmaceuticals, Inc., Summit, New Jersey.

Susan Canham came to the Garden in September, 1961, as a graduate assistant in the Cryptogamic Herbarium under Dr. Clark T. Rogerson, Curator of Cryptogamic Botany. Mrs. Canham is working toward her Ph.D. at Columbia University.

Elizabeth C. Hall, Sarah Gildersleeve Research Librarian, lectured on herbs and their uses at Sunlight House in Egypt, Massachusetts, under the sponsorship of the New England Unit of the Herb Society of America and the Green Thumb Garden Club. Miss Hall was interviewed for a broadcast on a weekly garden program in Providence, R. I., sponsored by the Rhode Island Federation of Garden Clubs. While in Providence, Miss Hall visited several libraries including the John Carter Brown Library, famous for its rich Americana collection. Miss Hall attended the dedication ceremonies of the Rachel McMasters Miller Hunt Botanical Library in Pittsburgh, as did Mrs. Hermann G. Place, a Vice President of The New York Botanical Garden, Dr. Harold W. Rickett, Bibliographer and Senior Curator of the Library, and Dorothy E. Hansell, Editor of *The Garden Journal*.

Mrs. Hansell judged flower shows of the Passaic Township (New Jersey) Grange 181 and the Royal Liverpool Insurance Group, and the dahlia show sponsored by the New Jersey Dahlia Society and the American Dahlia Society. She

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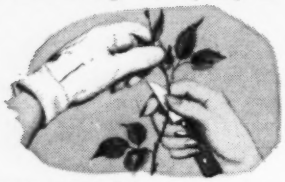

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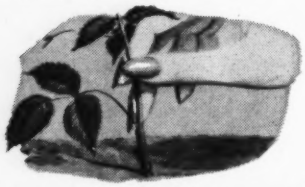

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attended a meeting of Region 19 of the American Iris Society held at Rutgers University, the conference of the Central Atlantic Region of the National Conference of State Garden Clubs held at Atlantic City, the sixteenth annual American Horticultural Congress held at Northhampton, Massachusetts.

Charles C. Clare Jr., Staff Artist, spent his summer vacation on a farm in Ashfield, Massachusetts. He devoted much of his time to making line drawings for a book on trees for students up to high-school age. The book, entitled *The Study of Trees Made Simple*, by Solveig Russell, is one of the "Made Simple Series" published by Doubleday & Co., and is expected to be available in the fall of 1962.

The National Trust for Historic Preservation met in New York City on October 13-16, 1961. Among the places visited was the Lorillard Snuff Mill at The New York Botanical Garden. Mrs. Hermann G. Place was Chairman of the New York Committee for the 1961 meeting.

Visitors to the Garden.

Prof. Richard M. Straw, Department of Biology, Los Angeles State College, Calif.

F. Bruce Lamb, U. S. Plywood Corp., New York, N. Y.

Dr. William Crotty, Department of Biology, New York University, New York, N. Y.

Dr. Mehmeh H. Kayacick, on a tour arranged by U.S.D.A. Foreign Agricultural Service Training Division.

Ludwig H. van Kanten, Department of Economic Affairs, Paramairibo, Surinam.

Rev. Luis J. Archer, S. J., Department of Botany, Instituto nun Alvers Caldas de Saude (Minko), Portugal.

Dr. Herman Wister, Plant Pathologist, National Capital Parks, Washington, D. C.

Dr. H. Bentley Glass, Johns Hopkins University, Baltimore, Md.

Dr. Mehmet Oner, University of Atatürk, Erzurum, Turkey.

Vyi Moosad, University of Wisconsin, Madison, Wisc.

Dr. Floyd L. Brown, Austin Peay State College, Clarksville, Tenn.

Dr. Hans E. Green, Farlow Herbarium, Harvard University, Cambridge, Mass.

Dr. Norman V. Rothwell, Long Island University, Brooklyn, N. Y.

Alma T. Walker, Athens, Georgia.

Claire Berg, Botany Department, University of Chicago, Ill.

Dr. Sydney Smith, St. Catherine's College, Cambridge, England.

Mrs. Arthur M. Anderson, who had been a member of the Corporation of The New York Botanical Garden since January 9, 1933, died on August 27, 1961. Mrs. Anderson was also a member of the Advisory Council from February, 1931.

Thomas Reynolds died on August 19, 1961, at the age of seventy-eight. He had served the Garden for thirty-five years. Mr. Reynolds, a foreman at the Power House, was given sick leave from December 26, 1960 until May 1, 1961; then was on terminal leave at the time of his death.

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Dr. Walter A. Egler, Director of the Museu Paraense Emilio Goeldi, Belém, Brazil, died by drowning on the Museu's, the Instituto Agronomico do Norte's, and The New York Botanical Garden's expedition in Amapa, Brazil, led by Dr. Egler and Dr. Howard S. Irwin of the Botanical Garden. Dr. Egler lost his life when his canoe was swept over a waterfall the fore part of September, 1961.

Fortunato Zandegiocomo died suddenly at the age of seventy-two years. He had served the Garden as a skilled carpenter and loyal employee for twenty-six years, and was pensioned in November 1960.

Robert B. Clark assumed the duties of Assistant Director of the Bayard Cutting Arboretum, Oakdale, Long Island, on September 15, 1961. He had previously been Assistant Professor of Ornamental Horticulture in the College of Agriculture, Rutgers University, The State University of New Jersey.

Robert A. Bartlett has been elected President of the Bartlett Tree Experts, succeeding Orville W. Spicer, who retired in September, 1961, after twenty-four years as president and forty-six years of service with the Bartlett company.

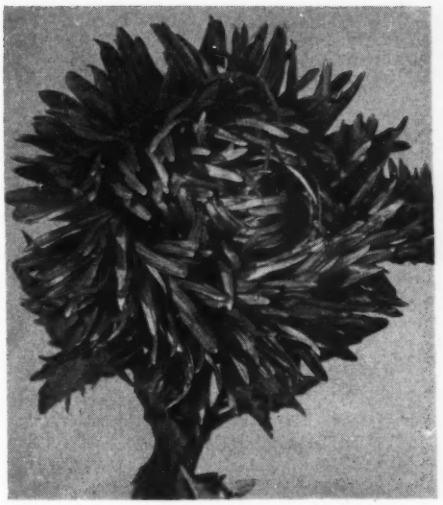
Mr. Bartlett in 1937 joined the Bartlett firm, which was founded by Dr. F. A. Bartlett, now chairman of the board. He was elected vice president in 1950 and executive vice president in 1954.

Mr. Bartlett attended Syracuse University and Columbia University, and at one time was with the Forest Pathology Department of the United States Department of Agriculture at Yale University. He is a member of the National Shade Tree Conference, the Northeast Weed Control Conference, the Virginia Public Utility Brush Control Conference, the Connecticut Tree Protective Association, the New Jersey Federation of Shade Tree Commissions, and the New York Arborists Association.

Mr. Spicer is co-author of the revised Spicer-Felt formula for shade-tree evaluation and is also widely known as an author and lecturer on shade-tree care. For years he served on the advisory and executive committees of the National Shade Tree Conference and has been identified with many horticultural and tree protective organizations.

A Day at Fordhook Farms. Mr. and Mrs. David Burpee entertained members of the horticultural press and other horticulturists from New York, Philadelphia, and Washington, D. C., at Fordhook Farms in Doylestown, Pennsylvania, on August 24, 1961. The original part of their beautiful home was built sometime between 1750 and 1780. Close by is the old icehouse and just beyond, nestled against the sloping ground, is the old springhouse. In front of the original entrance are two broad-spreading lindens which cast welcome shade on the stone terrace. One of these is considered to be the largest linden in the state of Pennsylvania. Mr. and Mrs. Burpee share a deep interest in trees, and many magnificent specimens grace Fordhook Farms. A majestic white pine has been named "Old Warrior"; its asymmetrical contour is proof that it has weathered many storms.

Mr. Burpee's father, W. Atlee Burpee, bought the property in 1876 and started the trial grounds in 1888, a year after he had etsablished the W. Atlee Burpee Co. David learned the seed business under his father. He left Cornell University as a freshman in 1913 to help with the family business because of his father's serious illness. At his father's death in 1915, David assumed charge of the firm; it was incorporated two years later. He has since served as president and general manager.



Aster 'Radiance'.

Mr. Burpee briefed his guests on some of the research work for and development of better strains of annuals and vegetables that have been carried on at the W. Atlee Burpee Co. farms at Lompoc and Santa Paula, California, and at Fordhook Farms. The seeds are raised in California, since the climatic conditions there are more favorable to large-scale seed production than are conditions in the East. Extensive experimental grounds are maintained at Fordhook Farms, as also at Lompoc and Santa Paula. A tour was made of these grounds, where the visitors saw some of the Burpee introductions for 1962. They also saw the trials of All-America Selections which are conducted at Fordhook Farms.

Highlights of the 1962 flower novelties in our opinion were aster 'Radiance' which produces semi-quilled flowers of scarlet-rose, as much as four and a half inches across, on sturdy, two-foot-tall plants; marigold 'Primrose Climax', an American F_1 hybrid, which bears its fully double, globular flowers of a cool primrose-yellow from midsummer till frost; snapdragons 'Glacier' with strong spikes of large florets on a base-branching plant, and 'Super-Jet', an F_1 hybrid, with double, frilled, clear yellow florets on tapered spikes; and zinnia 'Red Man', one of the Burpeeana Giants. These zinnias, bearing large terminal flowers on short, stocky plants, have been developed especially for today's low or one-story houses. The ruffled and quilled flowers of the Burpeeana Giants come in white through yellow, pink, red, violet, and purple. In 1951, one of the Burpee staff horticulturists noticed some plants that were considerably shorter than average in rows of hybrid zinnias. He covered these plants with mesh to keep the bees away, and later they were hand-pollinated. The plants raised from the resulting seeds were "screened out" each year until the desired type was obtained.

Dorothy Ebel Hansell, Editor of *The Garden Journal*, and Howard Swift, Assistant Curator of Education, represented The New York Botanical Garden.

A planting of Burpeeana Giant zinnias.

Torrey Botanical Club, Fall-Winter 1961 Program. On October 7, 1961, a combined field trip and meeting was held at The New York Botanical Garden. Anne Seaman led the group through the Thompson Memorial Rock Garden, Dr. Annette Hervey on a tour of the Research Laboratory, and Elizabeth C. Hall on a tour of the Library. After a buffet supper in the Seminar Room in the Laboratory Building, the members related their summer experiences.

On October 17, 1961, Dr. James Gunckel of Rutgers University lectured on "Tumor Formation in a Tobacco Hybrid: Cytological, Morphological, and Physiological Aspects." On November 7, 1961, Dr. Martin H. Zimmerman, of the Maria Moors Cabot Foundation for Botanical Research at Harvard University, spoke on "Structure of Tree Bark and the Transport of Organic Substances."

Charles H. Callinson of the Audubon Society will discuss "The Battle for Wilderness Preservation" on November 21, 1961, at Columbia University; Dr. Elsa H. J. O'Donnell, Visiting Research Associate of The New York Botanical Garden, "Nucleolar Structure" at Fordham University on December 5, 1961; Dr. Seymour Hutner, Director of Haskins Laboratories, "Growing Photosynthesis Bacteria," at Columbia University on December 19, 1961.

At the annual dinner and meeting, to be held in the Men's Faculty Club of Columbia University on January 16, 1962, Dr. William C. Steere, Director of The New York Botanical Garden, will deliver his presidential address. His subject will be "Bryophytes in Experimental Research."

The Litchfield Hills Audubon Society has recently published a brochure on *Herbicides, 60 Questions and Answers concerning Roadside and Right of Way Vegetation Management.* The questions and answers cover General Importance; Engineering Requirements; Botanical Technology; Commercial Technique; Conservation, Health, and Landscaping. The brochure was prepared by Dr. Frank E. Egler. Copies may be obtained at twenty-five cents each, or one hundred copies for twenty dollars, from the Service Department, National Audubon Society, 1130 Fifth Avenue, New York 28, N. Y.

BOOK REVIEWS **(Continued from page 227)**

We are also told about herbs and herb gardens, and the many nurseries from 1850 to the present time are described. There are also biographies of the numerous gardeners who owned and operated the nurseries and of others who planted fine gardens, and the plants each one introduced are described. As might be expected, many of the gardeners were born and trained in England.

Miss Padilla does not confine herself to introduced plants, but gives an enthusiastic account of the California natives.

There is also a chapter on the development of the flower-seed industry, which is conducted as scientifically as a factory wherein aeroplanes or missile weapons are being manufactured.

The last chapter tells about botanical gardens and is inspiring to those of us who are interested in similar local institutions.

The illustrations are not artistic, but serve to clarify the story. There is an excellent bibliography.

HELEN M. FOX
Mt. Kisco, New York

CHARLES DARWIN. Wichler, Gerhard. 228 pages, 24 plates, indexed. Pergamon Press, New York. 1961. $6.50.

Although the acknowledged purpose of this well-documented book is to demonstrate that we owe to Charles Darwin alone the positive proof of his theories of descent and natural selection, Professor Doctor Wichler has given us as an added bonus an accurate picture of science in general during Darwin's era and the historical background leading to the theory of evolution in particular. Carefully and dispassionately, he has assembled as evidence excerpts from Darwin's voluminous correspondence and publications that present a fair, unbiased account of Darwin as a scientist, the various stages in the development of his theories, and their reception by his contemporaries. An index of names and another of subject matter facilitate the use of the book material.

Dr. Wichler has brought out, too, many subordinate factors that he considers significant contributions to Darwin's achievements: happiness in home and family, despite chronic illness; freedom from all financial worries; the blessing of friendship and cooperation of the great scientists of the day, not all of whom were in accord with his theories of descent and selection. We are given brief sketches of these several contemporaries and the important part played by each in bringing Darwin's researches to a conclusion.

From all of this there emerges, in addition, the portrait of a great thinker, at once modest and humble, frequently distrustful of his own ideas, but always sincere in his search for truth. This book is a definite contribution towards a more thorough understanding of Darwin and his theory of evolution, not only by the student of science, but the lay reader as well.

CAROLINE K. ALLEN

ROADSIDE FLOWERS OF TEXAS. Wills, Mary Motz. Text by Howard S. Irwin. 295 pages, illustrated, indexed. University of Texas Press, Austin, Texas. 1961. $5.75.

Mary Motz Wills has been painting the flora of Texas for over fifty years, and this volume brings together two hundred and seventy-five reproductions of her delightful water colors of the more common wild flowers the average person might encounter along the roadsides.

The botanical text is written by Howard S. Irwin, formerly on the staff of the Botany Department of the University of Texas, now at The New York Botanical Garden. He gives short descriptions, Latin and common names, and distribution of the plants portrayed and references to related species. The indexed map of the counties of Texas might be of assistance for locating plants of limited range.

The plates occupy the first part of the volume. They are arranged in systematic order and the amateur will find them easy to use as the numbers of the plates appear prominently in the text.

This book could be a helpful companion for anyone who is unfamiliar with Texas plants and planning a motor trip through this section of the country.

LYNETTE L. SCRIBNER

THE PHYSIOLOGY OF PLANTS. Quer, Font P. 126 pages. Illustrated. Harper and Bros. New York. 1960. $2.25.

Professor Quer, former director of the Barcelona Botanical Institute, has written an elementary "Science Today" book on plant physiology for the grammar school child. It is cleverly written and illustrated and can be unhesitatingly recommended.

RICHARD M. KLEIN

LETTERS TO THE EDITOR

Sorry I was unable to obtain a good photograph of loquat *(Eriobotrya japonica)* in my shrub border before the deadline for the September-October issue. However, as it is a nice specimen, I am sending the photo anyway. Perhaps readers of *The Garden Journal* may be interested in seeing how well this shrub from China and Japan grows in my garden. It is grown in California, Florida, and similar frost-free regions for its acid fruits that are used in preserves and pies.

Loquat *(Eriobotrya japonica).*

JUNE RAINSFORD HENDERSON
Aiken, South Carolina

The September-October 1960 issue of *The Garden Journal* carried an article by Dr. Seymour Shapiro on "Radiation: An Aid in Plant Improvement."

In connection with this article, I thought your readers might be interested to learn what has been done here at Holden Arbortum with the decorative European alder, *Alnus glutinosa.* This tree, unfortunately, is very susceptible to leaf miner which results in brown blistery leaves and reduces its value as an ornamental. The Arboretum had several thousand dormant seeds bombarded with cobalt-60 gamma rays—a dose of 16,000 r., in November 1957. Many failed to germinate, a few survived but were chlorotic and lived just a short time. Only one seedling of all the progeny appeared to be different from the original species. We assumed that the irradiation causd the curious change and brought about a new form of *A. glutinosa.*

(Continued on Inside Back Cover)

This cultivar appears to be immune to the pests that plague the species. The leaves are concave, glossy, deep green, and of a leathery texture. What the ultimate height of this tree will be we do not yet know.

Appropriately it has been named *A. glutinosa* 'Holden'.

Holden Arboretum anticipates further experiments with radiation in its search for improvements in other selected trees.

LEWIS F. LIPP, Horticulturist
Holden Arboretum
Mentor, Ohio

We wish three extra copies of the July-August issue of *The Garden Journal* for our executive committee.

We are most happy to learn from this issue that The New York Botanical Garden is to have its own Native-Plant Garden. I hope those responsible for its development will feel free to call on us, if we may help in any way. We have been at it for twenty-seven years, and we can tell any one a great deal about what *not to do!* Sometimes that is valuable, too.

MRS. LYNWOOD R. HOLMES, Chairman
Bowman's Hill Wild Flower Preserve

MEMBERSHIP

We were delighted to welcome the following new members between July 1, 1961, and September 30, 1961.

NEW MEMBERS

Husband and Wife

Mr. and Mrs. James W. Angell
Mr. and Mrs. Donald S. Badaracco
Mr. and Mrs. Howard Belasco
Mr. and Mrs. Gordon S. Braislen
Mr. and Mrs. Peter Brown
Mr. and Mrs. Ernest Brumer
Mr. and Mrs. Mark A. Feiner
Mr. and Mrs. Louis Forer
Mr. and Mrs. Leonard Franklin
Mr. and Mrs. I. Friedman
Mr. and Mrs. Gerald Goldstone
Mr. and Mrs. Frank Grober
Mr. and Mrs. Charles J. Hybarger
Dr. and Mrs. E. Janowitz
Dr. and Mrs. H. Robert Kutil
Mr. and Mrs. Peter T. Lopez
Mr. and Mrs. James B. Liberman
Mr. and Mrs. H. P. Martin
Dr. and Mrs. Irving Parnes
Mr. and Mrs. Robert L. Ross
Dr. and Mrs. Bernard A. Sachs
Mr. and Mrs. Jerome Shapiro
Mr. and Mrs. Herman Schwartz
Mr. and Mrs. Victor Taborga

Annual

Mrs. David Adler
Herman Arthur
Herman Banks
Charles Batchelor
Mrs. F. Bates
Mrs. Franklin Benkard
Mrs. Jason Berger
Hugh Brooks
Dr. Paul W. Cohen
Miss Selma S. Cohen
Miss Alice V. Conklin
Mrs. Flora Cooper
Hardin L. Crawford III
William I. Crow
Mrs. J. H. Crown
Miss Carol C. Drought
L. C. Dunn
Joseph A. Durante
Mrs. Anthony Favor
Lawrence Friedman
Mrs. Margaret S. Garson
Miss Emily Gildenberg
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